WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

Amendment 9 to the Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region

Proposed Actions:

1) Establish an annual harvest guideline for the number of blue sharks taken in the Hawaii longline fishery

2) Establish a trip limit for non-blue sharks in the Hawaii longline fishery

3) Define bottom longline gear and prohibit its use for Pelagic Management Unit Species in the US EEZ around Hawaii

Including an Environmental Assessment,
Regulatory Impact Review/Regulatory Flexibility Analysis and
Proposed Regulations

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Western Pacific Regional Fishery Management Council
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1 Cover Sheet

2 Summary

The removal of fins from sharks, commonly referred to as finning, has emerged as a controversial practice. Sharks are caught, and finned, in various domestic and foreign fisheries. But the Hawaii-based longline fleet stands out because of the rapid increase and large absolute number of sharks that are being finned--over 60,000 in 1998. The Hawaii-based fleet does not target sharks, but they are a large incidentally-caught component of the total catch. At the same time, demand for shark fins, driven by rising incomes in the Far East and an emerging market among Asian-Americans on the US mainland, has grown. Shark fins are used to make a variety of delicacies esteemed in many Asian countries, including soup. Shark fins thus command a high price in regional markets, creating an incentive for fishers to fin. Crew members on Hawaii longliners supplement their income from fin sales, which are sold to local brokers in Hawaii. A higher volume of fins, from foreign longliners, is transshipped through US-flag ports in the region. Finally, US purse seiners delivering to canneries in American Samoa also sell fins to local brokers. Pressure to limit or prohibit the practice is due to concerns about the sustainability of catching and killing large numbers of sharks; many species have inherently low productivity and are thus vulnerable to depletion. The practice is also seen as wasteful because in most cases the carcass is discarded after the fins have been removed. Some conservation groups see the two issues as linked. The high prices commanded for fins and their ease of storage aboard vessels (in contrast to retention of the whole carcass) results in greater exploitation. Many conservationists also view finning as inhumane or culturally offensive.

This amendment addresses the issue of shark finning and several other concerns related to shark management. After consideration, the Council chose as its Preferred Alternative an initial annual harvest guideline of 50,000 blue sharks (*Prionace glauca*) that may be landed by the Hawaii-based longline fishery. Since only the fins are landed, a proxy must be used for monitoring landings. In addition, the Preferred Alternative proposes a limit of one shark of any other species besides blue, landed whole or dressed, per vessel per fishing trip. The existing framework procedure, implemented by Amendment 7, would allow these guidelines to be adjusted as more is learned about the stock characteristics of incidentally caught sharks. It was decided not to impose measures mandating that blue shark carcasses be landed because there is currently no market for the meat from this species, the most frequently caught shark species in the fishery. It is considered preferable to return their carcasses to the sea rather than putting them in landfills, which would very likely happen if landing them was required. Among the other measures that were considered, one was adopted. Because one vessel targeted near shore sharks in the Northwestern Hawaiian Islands (NWHI) in 1999 using bottom longline gear, concerns were raised about the impact of this fishery on the endangered monk seal. In order to prohibit this gear type, it must first be defined and then prohibited. Therefor, as its Preferred Alternative, the Council chooses to define this gear as bottom longline (differentiated from pelagic longline) and prohibit its use in the existing longline prohibited areas in the NWHI and the Main Hawaiian Islands.

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4 Introduction

4.1 Responsible Agencies

The Western Pacific Regional Fishery Management Council (Council or WPRFMC) was established by the Magnuson Fishery Conservation and Management Act of 1976 (Public Law 94-265; 16 U.C.S. 1801 et. seq.) to develop fishery management plans (FMPs) for fisheries operating in the US Exclusive Economic Zone (EEZ) around American Samoa, Guam, Hawaii, the Northern Mariana Islands and the remote US Pacific Island possessions.[1] Once an FMP is approved by the Secretary of Commerce (Secretary), it is implemented by Federal regulations which are enforced by the National Marine Fisheries Service (NMFS) and the US Coast Guard, in cooperation with state agencies.

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4.2 Public review process and schedule

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5 Existing Management Measures

5.1 The management plan and its amendments

[1] Howland Island, Baker Island, Jarvis Island, Johnston Atoll, Midway Island, Kingman Reef, Palmyra Atoll, and Wake Island.

The original Fishery Management Plan for the Pelagic Fisheries of the Western Pacific Region (FMP) became effective on March 23 1987. The plan addressed several immediate issues such as the regulation of foreign fishing vessels in US Pacific insular EEZ waters through fishing permits and area closures, the prohibition of drift gill net fishing except for experimental purposes, observer requirements and catch reporting definition of pelagic management unit species. **The definition of the management unit included the oceanic species belonging to the families Lamnidae (mackerel sharks), Alopiidae (thresher sharks), Sphyrnidae (hammerhead sharks) and Carcharhinidae (blue sharks and other requiem sharks)**

The plan also created a framework for the future management of pelagic fisheries within the EEZ of the Western Pacific Region. The FMP has been amended eight times to date; the remainder of this section contains brief descriptions of these FMP amendments and Council activity related to each amendment.

Amendment 1 to the FMP was implemented on 29 June 1991. It was drafted in response to the Secretary of Commerce Guidelines for the Magnuson Act National Standards requiring a measurable definition of recruitment overfishing for each species or species complex in a fishery management plan. The overfishing index expressed the current spawning population as a percentage of the original un-fished spawning population in the virgin stock, or spawning potential ratio (SPR). For pelagic teleost fish the SPR was set at 20% of the original un-fished spawning population. **For sharks, however, the Council recognized that these species were on the whole less resilient to fishing pressure and established a higher SPR of 35%.** The optimum yield (OY) for pelagic management unit species was also defined as the amount of fish that can be harvested by domestic and foreign vessels in the EEZ without causing local overfishing or economic overfishing.

Amendment 2 to the FMP was implemented on 31 May 1991 and requires domestic longline vessels to have federal permits and maintain federal fishing logbooks. It also requires the placement of observers on those vessels intending to fish within 50 nm of the Northwestern Hawaiian Islands. Finally, it implemented the application of the FMP to the Northern Mariana Islands.

Amendment 3 to the FMP was implemented on 18 October 1991 and establishes a 50 nm longline exclusion zone around the Northwestern Hawaiian Islands (NWHI) to protect endangered Hawaiian monk seals. Amendment 3 rendered the observer program implemented in Amendment 2 redundant since fishing was now banned in the area where observer coverage would be required. However, this 3 also contains framework provisions through which a mandatory observer program was implemented to collect information on turtle-longline interactions.

Amendment 4 to the FMP was implemented on 16 October 1991 and established a three-year moratorium on new entries into the Hawaii-based domestic longline fishery. The moratorium expired on 22 April 1994. The provision of imposing a mandatory vessel monitoring

system (VMS) policy for domestic longline fisheries in the Western Pacific Region was implemented under the framework process of Amendment 4.

Amendment 5 to the FMP was implemented on the 4 March 1992 and establishes a longline exclusion zone around the Main Hawaiian Islands (MHI) ranging from 50 to 75 nm and a similar 50 nm exclusion zone around Guam and its offshore banks. This zone was established to prevent gear conflicts and vessel safety issues arising from interactions between longliners and smaller fishing boats. A seasonal reduction in the size of the closure was implemented on 6 October 1992. Between the months of October and January, longline fishing is prohibited within 25 nmi of the windward shores of all islands except Oahu, where longline fishing is prohibited within 50 nm from the shore.

Amendment 6 to the FMP was implemented on 1 January 1992 and specifies that all tuna species are now designated as fish under the United States management authority. Amendment 6 includes tuna and related species of the genera *Allothunnus* spp, *Auxis* spp, *Euthynnus* spp, *Gymnosarda* spp, *Katsuwonus* spp, *Scomber* spp and *Thunnus* spp. Amendment 6 also propose application of the longline exclusion zones of 50 nm around the island of Guam and associated seamounts, and the 50/75 nm zone around the MHI to foreign longliners, purse seiners and baitboats. Prior to this amendment the foreign longline exclusion zones around Guam and the MHI/NWHI extended to 150 nm. The original foreign longline exclusion zones around American Samoa remained unchanged but applied equally to foreign purse seiners and baitboats.

Amendment 7 to the FMP was implemented on 14 January 1994 and instituted a limited entry program for the Hawaii-based domestic longline fishery. Amendment 7 limits the number of vessels in the fishery to 164 longline boats and these must not exceed 101 ft in length, the size of the largest vessel in the fleet prior to the moratorium period specified under Amendment 4.

Amendment 8 is part of a collective document that includes amendments to other Council FMPs, and was drafted in 1998 and partially approved on April 19 1999. **With respect to sharks, the document described the essential fish habitat (EFH) for oceanic shark species.**

5.2 Objectives of the FMP

The objectives of the FMP, as amended in Amendment 1, are

1. To manage fisheries for management unit species in the western Pacific region to achieve optimum yield (OY).

2. To promote, within the limits of managing at OY, domestic harvest of the management unit species in the Western Pacific EEZ and domestic fishery values associated with these species, for example, by enhancing the opportunities for:

a. satisfying recreational fishing experiences;

b. continuation of traditional fishing practice for non-market personal consumption and cultural benefits; and;

c. domestic commercial fishermen, including charter boat operations, to engage in profitable fishing operations.

3. To diminish gear conflicts in the EEZ, particularly in areas of concentrated domestic fishing.

4. To improve the statistical base for conducting better stock assessments and fishery evaluations, thus supporting fishery management and resource conservation in the EEZ and throughout the range of the management unit species.

5. To promote the formation of a regional or international arrangement for assessing and conserving the management unit species and tunas throughout their range.

6. To preclude waste of management unit species associated with longline, purse seine, pole-and-line or other fishing operations.

7. To promote, within the limits of managing at OY, domestic marketing of the management unit species in American Samoa, Guam, and Hawaii.

This amendment is intended to address objectives 1, 2c, 6 and 7, with regard to the oceanic sharks that are pelagic management unit species (PMUS). This document also identifies, as an issue, the need for better information to support assessment of oceanic shark stocks. This is in line with objective 4, but no new management initiatives, outside of what can be accomplished through existing administrative procedures, are proposed in this amendment. The Multilateral High Level Conference on the Conservation of Highly Migratory Fish Stocks (MHLC) is intended to develop a common management system for tuna and tuna-like species in the western and central Pacific. If the measures to manage the take of oceanic sharks outlined in this amendment are ultimately considered by the MHLC, then the amendment will also contribute to objective 5.

6 Purpose and Need for Action

The practice of finning sharks in the Hawaii-based longline fishery emerged as a major source of public concern in 1999. (Here finning refers to the practice of removing the fins, valued in Asian markets, and discarding the carcass.) The rate of finning in this fishery has increased substantially over the past five years. Broad public attention was sparked when on January 19, 1999 a domestic longline vessel, transshipping shark fins from foreign high seas longliners, was cited by Hawaii Division of Conservation and Resource Enforcement officials for transporting the fins without a licence.

Finning (that is, discarding the carcass at sea) has already been prohibited in US continental fisheries, partly because of concerns about the vulnerability of stocks but mainly

because the practice is viewed as wasteful. (In May 1999 an existing ban on 39 vulnerable species was extended to virtually all Atlantic sharks.) Thus the Hawaii fishery could be singled out as the only US domestic fishery in which finning was still being practiced. A bill was subsequently introduced to the Hawaii State House of Representatives during the 1999 session intended to prevent finning. Although the bill was ultimately killed during the 1999 session, a bill was again introduced during the 2000 session stating that "No person shall knowingly harvest shark fins from the territorial waters of the State, or land shark fins in the State, unless the fins were taken from a shark landed whole in the State." The bill was approved by the State legislature and at the time of writing it awaits the Governor's signature. Although the law is intended to also regulate vessels fishing outside of state waters, if they are licensed in Hawaii or land fish there, it seems likely that the Magnuson-Stevens Act, and thus the Council's management actions, would take precedence. Ultimately, the issue of the law's applicability may have to be resolved judicially.

In October the US House of Representatives passed US Resolution 189 calling for a ban on the "wasteful and unsportsmanlike" practice of finning in waters under Council jurisdiction. Proponents of the measure also petitioned the US Secretary of Commerce to impose a ban. The Earthjustice Legal Defense Fund, a Hawaii environmental group, sponsored an advertisement in the November 22 issue of the Honolulu Advertiser advocating "an end to this wasteful and biologically risky practice [i.e., finning], including a Secretarial intervention to begin rule making for an amendment to the Pelagic Fishery Management Plan for full utilization of all sharks." Although this statement was endorsed in the ad by numerous environmental groups, the Hawaii state government and the Office of Hawaiian Affairs, it runs counter to the Council's position. At an international level, the US has participated in an initiative sponsored by the United Nations Food and Agriculture Organizations Committee on Fisheries (FAO-COFI) to foster international cooperation and coordination for conservation and management of shark stocks. Minimizing unutilized incidental catches and maximum use of dead sharks are among the aims of this initiative.

Despite this opposition to the practice of shark finning, the Council has responded cautiously for two reasons. First, the best available scientific evidence indicates that the shark stocks exploited by the Hawaii longline fishery are not over-exploited. Second, greater utilization is unfeasible because no market currently exists for the meat of the blue shark (*Prionace glauca*), which represents the vast majority of sharks caught in the fishery. There are also serious barriers to processing and preserving blue shark meat on longliners, because of the physical characteristics of the meat and the constraints of vessel configuration. The Council supports efforts to develop markets for shark meat and overcome vessel constraints so as to increase utilization, but does not view a prohibition of finning as the best way to do so.

Sorting through the allegations and rhetoric resulting from sometimes heated public debate, four issues can be identified relating to shark finning. First, there is concern about the sufficiency of information on total fishing mortality to shark stocks. Foreign vessels, fishing on the high seas or the economic zones of other nations, account for most of the fishing mortality of

Pacific shark stocks. Catches and shark mortality by these vessels are poorly documented. This makes accurate stock assessment impossible. Second, because of their reproductive biology, many shark species are considered intrinsically vulnerable to overfishing. There is thus concern that the current catch in Council-managed fisheries is unsustainable. Third, finning is viewed as wasteful because a small proportion of the fish is utilized--less than 5% of the animal's total body weight (WPRFMC 1999, p. 18). Fourth, some members of the public attribute an intrinsic "existence value" to sharks. This is expressed in a variety of ways. People may see sharks as a "charismatic" member of the ecosystem. As one account puts it: "The loss of the graceful, mysterious creature disturbs the undersea ecosystem, removing an important predator that helps maintain the ocean's fragile balance of marine life..." (Kelly 1999a). Some consider finning inhumane, claiming that sharks are "thrown back into the water, more often than not, alive. It takes hours and sometimes days for the shark to die a slow and agonizing death" (Endreson and Morris 1999). However, it must be emphasized that, according to observer reports, 98% of sharks brought on board alive are killed before they are finned. Finally, some native Hawaiians argue that killing sharks is, as one activist states, "very culturally offensive to the Native Hawaiian people.... [because of] a mystical association we have [with sharks]" (Tighe 1999).

The Council has identified two additional issues relating to shark management. First, in 1998-99 a directed fishery for sharks, using bottom longline gear, was conducted in Hawaii. Once the fishery began, it became apparent that the existing regulatory definition for pelagic longline gear did not cover this method. Therefore, an existing management provision that prevents longlining in the exclusion zones around the Northwest Hawaiian Islands (NWHI) and main Hawaiian Islands (MHI) could not be applied, nor could this type of gear be regulated in other areas. Second, the definition for sharks designated as pelagic management unit species (MUS) is not specific; instead they are described as members of four families (Alopiidae, Carcharhinidae, Lamnidae, and Sphyrnidae). Thus coastal shark species, rarely or never caught in pelagic fisheries, are included under the Pelagic Fisheries Management Plan (FMP). Required management measures can be less burdensome and more effective if these species are excluded from the Pelagic FMP.

This amendment to the Pelagic FMP provides the basis for Council recommendations to address these issues. In summary, the concerns raised here are consolidated in five issues that the Council has considered and addressed:

1. Inadequate data on shark exploitation;
2. The potential for over-exploitation of shark stocks;
3. Public concern about waste and misuse, including low product recovery from finning and the impact of exploitation on "existence values";
4. The inability, under the current regulatory definition, to manage bottom longlining; and,
5. The non-specific definition for shark MUS in the Pelagic FMP.

7 Affected Environment

7.1 The biology of Pacific shark species and major exploited species

Taking the broadest perspective, numerous shark species are caught[2] in both coastal and pelagic fisheries around and within the Pacific basin. However, of those fisheries under council jurisdiction, most oceanic sharks are taken in the Hawaii-based longline fishery for tuna and swordfish. Sharks are also caught in the shore-based *alia* longline fishery in American Samoa and landed by purse seine vessels calling there, but to a lesser extent. (Sharks are not target species in any these fisheries. A recently developed bottom longline fishery in the NWHI, discussed below, does target sharks.) The vast majority of sharks taken in these fisheries are pelagic. For example, in the well monitored Hawaii longline fishery five species, or species groups, comprise almost all the sharks caught; these are the blue shark (*P. glauca*), oceanic whitetip (*Carcharhinus longimanus*), silky shark (*C. falciformis*) thresher sharks (*Alopias spp*), and mako sharks (*Isurus spp*). Further, just one species, the blue shark, represents about 95% of all sharks caught in the Hawaii longline fishery. Although blue sharks are cosmopolitan, they prefer water temperatures between 7º and 16º C and are thus more abundant in the subtropical waters north of Hawaii and blue shark catch rates are lower in more tropical waters around Hawaii and to the south.

Despite the fact that a few species of sharks represent the preponderance of catches in pelagic fisheries, oceanic sharks as pelagic management unit species are defined broadly, at the family level (Alopiidae- thresher sharks, Carcharhinidae- requiem sharks, Lamnidae- mackerel sharks, and Sphyrnidae- hammerhead sharks, a primarily coastal group) (50CFR600.12). At the same time, there are a few oceanic shark species that fall outside these four families; but they are rarely, if ever, caught by the pelagic fisheries under Council jurisdiction. In sum, although shark MUS are defined broadly, the vast majority caught in Council-managed fisheries are a single species, the blue shark.

One aspect of shark biology that has direct relevance to fisheries is the high level of urea (or more generally, non-protein nitrogen--NPN--compounds) in their flesh because of their primitive excretory and osmoregulatory system. This makes handling, processing and storing of sharks more difficult. NPN compounds give the flesh an unpleasant flavor and therefor many species of sharks have to be specially processed to rapidly remove them. These compounds also contribute to more rapid spoilage. The blue shark is particularly high in NPN compounds and thus there are several barriers to making their flesh marketable. For example, their flesh can be held on ice--the preservation system on Hawaii-based longliners--for no more than about five days.

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2 Throughout this document a distinction is made between to catching versus and landing fish. Catching refers to those organisms that are ‘brought to the gunwale’ by the fishing gear but may be released or discarded. Landing fish is defined as “offloading fish from a fishing vessel, arriving in port to begin offloading fish, or causing fish to be offloaded from a fishing vessel” (50CFR660.12). The number of sharks caught is by definition greater than the number landed. Council-managed fisheries do not target sharks, and until recently few sharks or shark parts were retained. Therefor, in these fisheries significantly higher numbers of sharks were caught than landed. But now landings are a higher proportion of total shark catch (see Figure 1) because finned sharks contribute to landings--by definition--even though a small portion of the shark is retained.

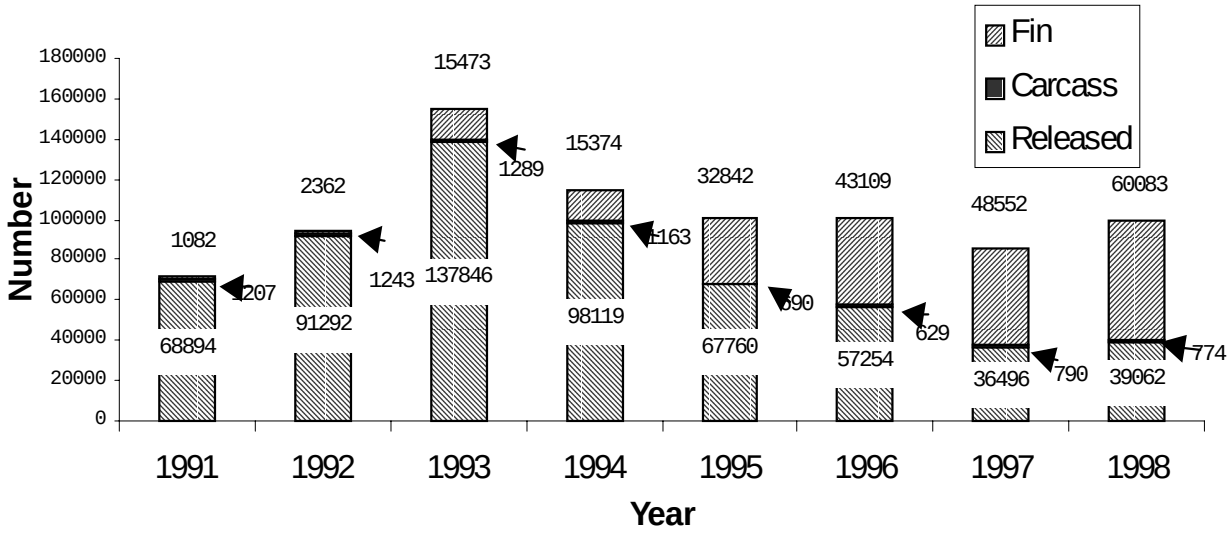

Figure 1. Annual shark catch and disposition in the Hawaii longline fishery (Source: Ito & Machado, 1999)

7.1.1 Description of the principal species

7.1.1.1 Blue shark

The blue shark is the most widely distributed of all the carcharinids and is found in temperate and tropical epipelagic waters throughout the world (Compagno 1984; Nakano and Seki in review). Although it is primarily an offshore species, it may venture inshore at night in areas with a narrow continental shelf and around islands. It is often found in large aggregations, frequently close to the surface. It prefers water temperatures 7º–16ºC but can tolerate water temperatures over 22ºC. It ranges far into the tropics but usually occurs at greater depths in the tropics than in temperate latitudes. In the Pacific, the blue shark is found in greatest abundance 20º–50ºN. In these latitudes it shows strong seasonal fluctuations in abundance as it moves northward in the summers and southward in the winter. In the tropics 20ºN–20ºS it is uniformly abundant throughout the year (Compagno 1984).

Like many sharks, blue sharks segregate by sex and size. In the North Pacific, females and smaller sharks are found farther to the north than males and larger adults. After reaching sexual maturity, individuals move southward into the mating area (Nakano and Seki in review). Mating appears to occur in a band from 20º–30ºN in the summer with pupping occurring in a band from 35º–45ºN the following summer.

The blue shark is viviparous (live bearing) and after a gestation period of 9–12 months may bear as many as 135 young per litter, although the average litter size is 26 pups. The number of pups per litter is strongly correlated with the size of the pregnant female. Individuals grow to 4

m but may reach 6–7 m. Sexual maturity occurs at 5–6 years of age for females and 4–5 years of age for males.

With their relatively fast growth, high fecundity, extensive distribution and apparent high abundance, blue sharks are the most productive of the oceanic sharks in the Pacific (Stevens 1996). (Table 1 summarizes the biological characteristics of the shark species discussed here).

Table 1. Distribution, ecological and biological characteristics of selected oceanic shark species

	Blue	**Oceanic whitetip**	**Silky**	**Shortfin mako**	**Thresher**
Distribution	Cosmopolitan in tropical and temperate seas	Cosmopolitan in tropical and temperate seas; seasonal in warm temperate seas	Circum-tropical; seasonal in warm temperate seas	Cosmo-politan in tropical and temperate seas	Cosmopolitan in tropical and temperate seas
Temperature range (˚C)	12-20	>20	>23	>16	?
Depth range (m)	0-400	0-150	0-500	0-400	0-400
Relative abundance	One of the most wide ranging and abundant sharks	Abundant in tropical waters	Abundant in tropical waters near to land masses	Generally less abundant	Generally less abundant
Length at birth (cm TL)	35-50	60-65	70-85	70	115-150
Length at maturity (cm TL)	M: 173-213 F: 187-213	M: 175-195 F: 180-200	200-210	M: 195 F: 265-280	M: 320-340 F: 260-400
Maximum length (cm TL)	380	300	330	400	600
Age at maturity (yrs)	M: 4-6 F: 5-7	?	6-7	M: 9 F: 15	M: 4-5 F : 3-7
Longevity (yrs)	20	?	20	45	45
Reproduction	Placental viviparity	Placental viviparity	Placental viviparity	Oophagy	Oophagy
Litter size (n)	avg: 35 max: 135	5-15	avg: 7 max: 15	4-18	2-4
Gestation (mos)	9-12	≈12	?	?	9

	Pupping season	Spring or summer	Spring or summer	Throughout the year	Late spring	

Source: Adopted from Stevens (1996).

7.1.1.2 Oceanic whitetip shark

The oceanic whitetip shark is distributed circumtropically but may venture into the warmest regions of temperate waters. This shark is primarily oceanic-epipelagic but occasionally moves into coastal waters. It is found in waters ranging 18º–28ºC, but usually prefers water temperatures above 20ºC. It is most abundant in the tropics 20ºN–20ºS. Oceanic whitetip sharks are viviparous with litter sizes of from 1–15 pups. Litter size is positively correlated with adult female size. Gestation is thought to be ~12 months (Compagno 1984).

7.1.1.3 Silky shark

The silky shark is found circumtropically from about 10ºN–10ºS in water temperatures of 23º–24ºC. It appears to be more abundant offshore near land than in the open ocean. Reproduction is viviparous, with 2–14 young per litter. There is no pronounced reproductive seasonality. Females mature at 2.1–2.3 m and males reach maturity at 1.8–2.2 m. Maximum size is thought to be 3.3 m. The silky shark is primarily piscivorous (fish eating) and often associated with schools of tuna (Compagno 1984).

7.1.1.4 Thresher and mako sharks

Thresher and mako sharks are large and active swimmers. They feed on small to moderate sized prey. Both of these sharks are circumtropically distributed in pelagic to nearshore waters. Thresher and mako sharks may also venture into temperate waters, although mako sharks are seldom found in water temperatures less than 16ºC. Thresher and mako sharks may reach a size of more than 4 m and are thought to attain sexual maturity at 2 m. Both thresher and mako sharks are ovoviviparous (producing eggs that develop within the maternal body and hatch

within or immediately after extrusion from the parent) and bear 2–4 young per litter (Compagno 1984).

7.1.2 Status of stocks

Because blue sharks comprise most of the shark catch in sub-tropical and temperate high seas fisheries, including the Hawaii-based longline fishery, its stock status is of great interest to managers. While Stevens (1996) cautions that the impact of high seas fisheries on the blue shark population is not fully understood, he notes that while they "are among the most widespread, fecund and faster growing elasmobranchs the general life history characteristics of this group limit their ability to withstand heavy fishing pressure." Nakano and Seki (in review) point out that total blue shark catch by ocean is not precisely known and no comprehensive stock assessment currently exists. However, they argue that analysis of available catch data does not suggest that the stock status is in a critical state.

This assertion is supported by historical fisheries data, which indicate that the north Pacific blue shark population has not substantially declined over the past several decades, despite heavy fishing pressure by international fleets. Matsunaga and Nakano (1999) analyzed catch data from Japanese longline research and training vessels. Two data sets were available, one from 1967-70 and one from 1992-95. Catch data were stratified by four geographic areas[3]. Blue shark comprised 73%-85% of total catch in the 10º-20º N strata and 31%-57% in the 0º-10º N strata during the two periods. Almost all Hawaii longline effort falls within the two west longitude strata. Mastsunaga and Nakano found that blue shark CPUE increased slightly from the 1967-70 to the 1992-95 period in these two strata (1.79 versus 1.91 for the 0º-10º stratum and 5.22 versus 5.82 for the 10º-20º stratum), but the difference was not statistically significant. (There was a marked, and statistically significant, increase in blues shark CPUE in the two east longitude strata.) Oceanic whitetip CPUE declined significantly in both west longitude strata. Silky shark CPUE increased significantly in the 0º-10º stratum and decreased slightly (but not statistically significantly at the 5% level) in the 10º-20º stratum. Thresher shark CPUE increased significantly in both strata.

Nakano and Watanabe (1991) attempted a stock assessment for blue sharks based on catch data from the high seas driftnet fishery (which ceased in 1992) with supplemental data from longliners. They estimated minimum stock size in the North Pacific at 52-67 million and argue that "even the minimum stock can sustain the present catch level although mortality rate at [the] early stage is not known for blue shark" (p. 4). However, other authors do not consider the information sufficient to make an adequate estimate of stock size (Wetherall and Seki 1991).

The NMFS Honolulu Laboratory has initiated several efforts aimed at increasing knowledge of blue shark stock characteristics (Laurs 1999). Most significant is a joint effort with

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3These are 0º-10º N and 10º-20º N between 140º E-180º longitude, and 0º-10º N and 10º-20º N between 140º W-180º longitude. The zones are designated by their latitude boundaries and longitudinal direction; thus 0-10E, 0-10W, 10-20E, 10-20W.

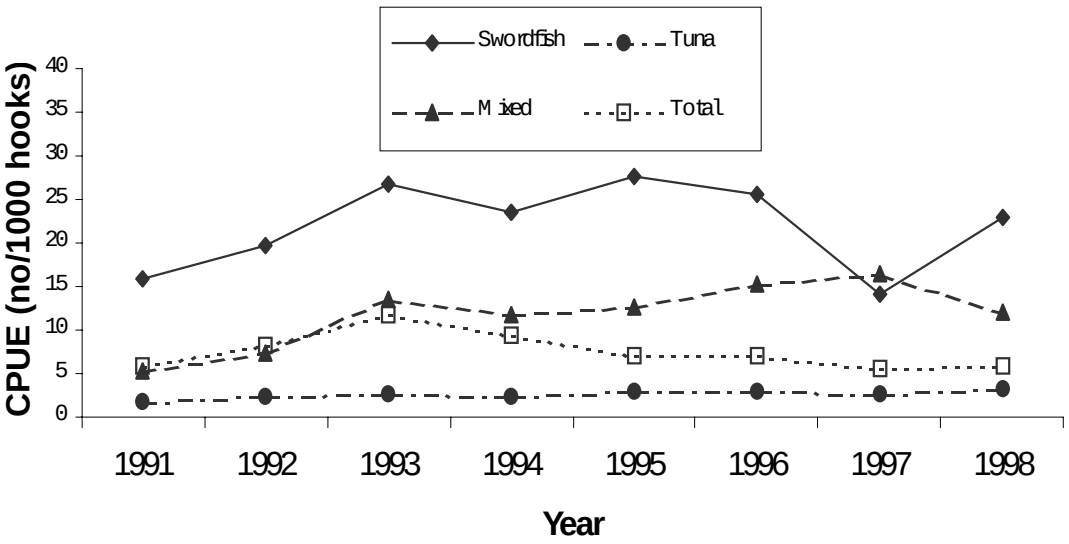

Figure 2. Annual catch rates of blue sharks in the Hawaii longline fishery by trip type

Japanese scientists to make a stock assessment for blue sharks. The Laboratory has also initiated a tag and release program for blue sharks.

Figure 2 shows blue shark CPUE trends as reported for the Hawaii longline fishery. Overall, there is a decline in CPUE. However, this is misleading because it is mainly due to a shift in effort away from swordfishing, where shark catch rates are higher, to tuna fishing, where they are lower. If, as shown in Figure 2, one looks at catch rates by trip type, there is no obvious declining trend. Although the available information presented here is far from definitive, it does not suggest that there is any immediate risk of longline fishing leading to a rapid decline in the blue shark population.

7.2 Exploitation of sharks in the region

It is important to realize that Council-managed pelagic fisheries are but one component in a diverse array of fisheries that target tuna and billfish, and conducted by both distant water-vessels and smaller, offshore vessels making shorter trips from a shore-base. These vessels come from a various Pacific Rim and Pacific Island nations and all have a significant incidental catch[4] of sharks. In fact, media attention in early 1999, which alerted the public to the issue, revolved around the transshipment through Hawaii of shark fins from sharks caught by foreign vessels fishing outside the US EEZ and thus outside the direct jurisdiction of the Council. As discussed below, for reasons related to the fact that sharks are not target species, it is difficult to determine shark catches by pelagic fisheries throughout the region with precision. Nonetheless, Stevens

4Bycatch is commonly used in a general sense to refer to the catch of non-target fish. But the Magnuson-Stevens Act defines bycatch more specifically as only those “fish which are harvested in a fishery, but which are not sold or kept for personal use, and includes economic discards and regulatory discards” (16USC1802). Accordingly in this document the term incidental catch is used to refer to non-target species ‘brought to the gunwale’ (see previous footnote) and retained, while bycatch refers only to fish that are discarded.

(1996) estimates that between 283,000 and 470,400 mt of sharks were landed by all high-seas Pacific fishing in 1994, of which 140,100 MT (30-50% of the total) were blue sharks. In comparison, the Hawaii-based longline fishery caught 99,919 sharks in 1998, representing a total weight of 4,000-4,500 mt in 1998.[5] Of this, an estimated round weight of 2,721 mt represents fishing mortality due to the landing of shark fins, carcasses, or both (Ito and Machado 1999).

7.2.1 Exploitation of sharks in major Pacific fisheries: Foreign and Council-managed fisheries compared

The Pelagic FMP provides an overview of foreign fisheries that were conducted in the US EEZ at the time of Plan formulation (WPRFMC 1986, pp. 6-14 - 6-35). Williams (1997) reviews incidental catch of shark in the Western and Central Pacific Ocean within the statistical area for the Oceanic Fisheries Program of the South Pacific Commission. (The Hawaii EEZ lies outside this area.) Hampton, et al. (1999) provide an overview of tuna fisheries in the Western and Central Pacific Ocean (WCPO). Currently three fisheries account for most of the landings of tuna and billfish: purse seine, pole and line, and longline.

Table 2: 1997 Annual landings for Pacific pelagic fisheries and estimated 1994 shark catches. All values (except percent) reported in 1,000's. (Annual landings from Lawson, 1998. Shark catches from Stevens (1996). Longline catches were re-calculated by country based on method and data in Stevens.)

Fishery	1997 Landings of Target Species, mt (percent of total)	Blue shark, mt (#)	Oceanic whitetip, mt (#)	Silky, mt (#)	Shortfin mako, mt (#)	Thresher, mt (#)
Purse Seine						
Japan	180 (19.2%)					
Korea	159 (16.9%)					
Taiwan	167 (17.8%)					
USA	144 (15.4%)					
Pacific*	57.8 (6.2%)					
Other**	45.2 (4.8%)					
Sub-total	**753 (80.3%)**	**2.3 (57.5)**	**7.0 (233)**	**11.7 (390)**	**?**	**?**
Longline						
Japan	41.9 (4.5%)	49.0 (1,438)	16.4-84.7 (546-2,824)	26.4 (880)	1.3 (31.9)	1.7 (23.9)
Korea	28.5 (3.0%)	30.0 (1,061)	9.0-46.3 (301-1,544)	14.4 (480)	1.0 (25.0)	1.0 (13.9)
Taiwan	20.1 (2.1%)	23.5 (899)	7.3-37.0 (243-1,234)	11.5 (383)	1.0 (26.0)	0.8 (11.7)
Pacific†	19.1 (2.0%)	33.9 (853)	12.4-64.4 (414-2,146)	20.1 (669)	0.8 (19.9)	1.2 (17.7)
Australia	3.0 (0.3%)					
Sub-total	**113 (12.0%)**	**136 (4,250)**	**45.1-232 (1,504-7,747)**	**72.4 (2,413)**	**4.1 (103)**	**4.7 (67.3)**
Pole & line	**65.4 (7.0%)**					
Troll	**6.6 (0.7%)**					
Total all	**938 (100%)**	139 (4,309)	52.1-239 (1,737-7,981)	84.1 (2,803)	4.1 (103)	4.7 (67.3)

*FSM, Kiribati, PNG, Solomon Islands and Vanuatu. **Australia, New Zealand and the Philippines. †For total catch only: American Samoa, French Polynesia, Vanuatu; for shark catch only: Cook I., Fr. Polynesia, RMI, New

5The total catch, which includes those released, is reported in numbers in Ito and Machado. The average weight for landed sharks, based on data in Ito and Machado, is 45 kg. Stevens (1996) uses an average weight of 40 kg for blue sharks caught between 20º N and 20º S. The range presented here is based on these values.(1996.)

Zealand; for both: PRC, Fiji, FSM, New Caledonia, PNG, Solomon Islands, Tonga, Western Samoa, USA (vessels based in RMI).

Purse seiners, primarily from Japan, Korea, Taiwan and the USA, account for about 60% of the total catch (by volume) in the WCPO. These vessels target skipjack tuna (*Katsuwonus pelamis*) but also catch yellowfin (*Thunnus albacares*) and small amounts of bigeye (*T. obesus*). Skipjack tuna landings have ranged between 600,000 and 700,000 mt per year prior to 1998, a record year with a catch of 1,158,326 mt. Most fishing effort is expended in the tropical western Pacific, primarily in Micronesian and Melanesian waters. Seiners freeze their catch and most of their landings are destined for processing into canned tuna. Sharks are the most common incidental catch in this fishery, according to observer data analyzed by Lawson (1997). Stevens (1996), using catch per unit effort and effort, data estimates that purse seiners caught 21,000 mt of sharks in 1994. (See Table 2).

Due to technological advances, purse seine vessels have largely replaced pole-and-line boats, which also target skipjack tuna. The pole-and-line fishery now accounts for 15% of the tuna catch in the WCPO, or 262,678 mt in 1998. Major fishing areas in the WCPO (based on expended effort) are around Japan (this is a seasonal sub-tropical fishery), eastern Indonesia and the Solomon Islands. There is a small pole-and-line fishery (called aku or baitboat) in Hawaii, but landings have declined substantially; in 1978-82 landings averaged 2,333 mt annually while 1998 landings were 318 mt. The pole-and-line fishery has a very low rate of incidental catch; according to a review of data from the western tropical Pacific, the rate is less than 1% and even at that low rate sharks occurred rarely (Bailey et al. 1996, p. 5-6).

The third main type of fishery uses longline gear. Broadly, two vessel types may be distinguished, large (>250 GRT) vessels with freezer capacity engaging in true distant-water operations and smaller (<100 GRT) 'offshore' vessels with ice or chill capacity that make short (days to a few weeks) trips from bases relatively near to the fishing grounds. Most of the larger vessels come from Japan and Korea. Many of the Pacific Island nations have small offshore fleets. Large numbers of Taiwanese and Chinese offshore vessels also entered the fishery in the early '90s, often based from Pacific Island ports, but the number has since declined. Longliners target bigeye and yellowfin tuna, which are by and large destined for either the fresh or frozen sashimi market, depending on vessel type. Albacore tuna (*Thunnus alalunga*), which are usually canned, are also caught in the South Pacific. The Hawaii-based longline fleet can be designated offshore (smaller vessels, ice preservation, shorter trips). Unlike elsewhere, the Hawaii fishery also targets swordfish (*Xiphias gladius*) in addition to bigeye, albacore and yellowfin tuna. Although it is the largest commercial fishery in the Council region, both by landings and value (see Table 3), in comparison to total WCPO landings the numbers are small. In 1998 Hawaii longline fishery landings were reported at 12,973 mt while total WCPO longline catches have been between 150,000-200,000 mt annually for the past 25 years (Hampton et al. 1999, p. 9). In the Western Pacific shark incidental catch by longliners is estimated at 258,600-446,700 mt in 1994 (Stevens 1996). Thus this fishery has by far the highest catch rate of sharks for any of the major pelagic fisheries considered here (see Table 2). In comparison, reported shark landings

(back calculated to round weight) represent about 18% of total catch.[6] (See Table 3 and Section 7.2.3.1 below for a more detailed discussion of incidental shark catch in the Hawaii longline fishery.)

Table 3: Landings and value of pelagic fisheries in the Council region (1998). (Source: WPRFMC 1998 Annual Report. Landing value for Hawaii longline fishery is estimated round weight.)

	Total landings (mt)	Value ($)	Shark landings (mt)	Comments
American Samoa				
Longline	401.05		3.26	
Troll	11.46		0.10	
Total	412.51	$998,930	3.36	
Guam				
All pelagic fisheries	370.62	$711,066	3.64	
Hawaii				
Longline	12,972.40	$46,651,000	2815.45	
Aku baitboat	315.70	$932,000		
troll & handline	1,496.9	$7,226,000	42.2	Shark landings for all non-longline fisheries
Other	589.7			Value included under troll & handline
Total	15,376.8	$54,809,000	2,843.6	
CNMI				
All pelagic fisheries	89.16	398087	?	
Total	17,696.49	$56,917,083	2,850.57	

There are a variety of other small-scale and/or artisanal fisheries that target tuna in the WCPO. The only other commercial fishery to be regularly monitored by the SPC Oceanic Fisheries Program is the South Pacific troll fishery, which targets albacore tuna along the Sub-tropical Convergence Zone occurring near 40º S. Vessels come from New Zealand and the US. Annual catch peaked in 1986 at 9,000 mt but has since declined to about half that level. There are also local troll fisheries in the US-flag states under Council jurisdiction. The largest is in Hawaii, landing 1,360 mt in 1998. According to Bailey, et al., (1996) blue, mako (*Isurus oxyrinchus*) and thresher (*Alopias vulpinus*) sharks are caught in the South Pacific fishery, but rarely.

It should be noted that the high seas drift net fishery, conducted by vessels from Japan, Taiwan and Korea and targeting albacore tuna, operated from 1982 to 1993 when it was prohibited by international agreement.[7] In its peak season of 1988-89, 21,955 mt of albacore

6Total shark catch, including released sharks, would be a slightly higher percentage.

7There were also driftnet fisheries for salmon and squid in the north Pacific that also ceased in 1993 due to the agreement.

were landed (Lawson 1998). Stevens (1996) estimates that 21,152 mt of blue sharks, 520 mt of shortfin mako sharks and 2,700 mt of thresher sharks were caught in the 1989-90 season.

7.2.2 Foreign vessels fishing outside the US EEZ but transshipping shark products at US ports

McCoy and Ishihara (1999) extensively review the disposition of shark incidental catch by foreign vessels that land or transship shark products through US ports in the region. Taiwanese longline vessels offload frozen catch in both Guam and American Samoa. In Guam, the target species, bigeye and yellowfin tuna, are transhipped to the sashimi market in Japan, while lower grade tuna are sold in local markets. In American Samoa smaller, older vessels deliver albacore tuna to local canneries while larger, newer vessels, equipped with ultra low temperature (ULT) refrigeration systems, also target bigeye and yellowfin for the sashimi market, depending on market conditions. Taiwanese operators, more than those of other major Pacific fishing nations, see landings of shark products as an integral part of their operations. In the tropical western Pacific these vessels often retain carcasses from shortfin mako (*Isurus oxyrinchus*), oceanic whitetip (*Carcharhinus longimanus*) and silky (*C. flaciformis*) sharks, depending on the constraints of hold capacity and trip duration. (Higher valued target species will always be retained in preference to non-target species.) Blue sharks are normally finned and discarded because of the low value of blue shark meat.

Japanese longline vessels also transship through Guam. In 1999 50-60 vessels, mostly owned by small family-run businesses (owning two or there fishing vessels), were based in Guam. These vessels fish in the EEZs of Palau and the FSM, and on the high seas of the western Pacific. Japanese vessel operators put much less emphasis on the retention of shark products, partly because of vessel capacity constraints. Dried shark fins are sold to a local buyer who exports the product to Hong Kong. Generally, any income derived from the sale of shark fins is shared out among the crew to augment their income. This contrasts with the Taiwanese vessels where, as noted, the sale of shark products is considered by vessel owners as an important part of their fishing operations and they garner revenue from landed shark products.

Foreign high-seas longliners operating in the north Pacific have been transshiping shark fins through Hawaii for most of this decade. While vessels hail from Japan, Korea and Taiwan, most transshipments are made by Korean ULT longliners. These vessels stay out at sea for months at a time, freezing their catch of sashimi-grade bigeye tuna. Catch is periodically transferred at sea to refrigerated carrier vessels (or “reefers”). They are also re-supplied with fuel and provisions at sea by tankers. These tankers put in at Honolulu to purchase fuel and supplies. This provides a convenient mechanism for the transshipment of shark fins. The tanker captains purchase shark fins from the high-seas longliners they service. US-flag vessels, including some Hawaii-based longliners, are contracted on a casual basis to transport fins from tankers to Honolulu. Typically, they meet the tanker as it heads into Honolulu and receive the cargo in international waters. (This mechanism is used because the Nicholson Act precludes foreign-

flagged vessels from landing fish in US ports.[8]) In Honolulu the fins are transferred to shipping containers for onward shipment to Asia. As McCoy and Ishihara note, this trade is done on behalf of other brokers and is not important to the supply vessel's revenues. Rather, in this highly competitive business supply vessel captains and owners see the trade as "a necessary service that must be provided to attract the maximum number of customers"
(McCoy and Ishihara 1999, p. 92).

7.2.3 Domestic (US flag) fisheries

While there are west coast-based US domestic fisheries that catch large numbers of sharks (primarily off the California coast) these are outside the Council's jurisdiction and will not be detailed here. Fisheries that catch sharks and are within the Council's region are described below.

7.2.3.1 Hawaii-based pelagic longline fishery

The Hawaii-based pelagic longline fishery developed and expanded rapidly in the late 1980s and early '90s. As already noted, this is now the largest fishery, in terms of landings by both value and weight, currently managed by the Council (see Table 3). Although much of this fishing occurs outside the US EEZ, it is managed by the Council because the range of the relevant fish stocks include the EEZ and the vessels are US-flagged and based in Hawaii. The number of sharks being finned has also increased. While the total number of sharks caught in the longline fishery has remained relatively constant over the past five years (see Figure 1), the number landed has increased substantially, from 2,289 in 1992 to 60,857 (of which 60,083 were finned and 774 retained whole) in 1998 (Ito and Machado 1999). This rapid expansion was due in part to the entry of vessels from the Atlantic and Gulf coasts of the US as those fisheries became overcapitalized. In addition, east coast fisheries were more tightly regulated in comparison to Hawaii fisheries; thus a move into the region was seen as promising because of the less constraining regulatory environment. An important part of this growth constituted targeting on swordfish (primarily by larger vessels that can make extended trips into rougher north Pacific waters) although landings have declined since the first half of the 1990s. Hawaii longliners also target bigeye, yellowfin and albacore tuna and some vessels undertake so-called "mixed trips" where both swordfish and tuna are targeted (He et al. 1997).

The fishing strategy for swordfish differs from that for tuna and this has relevance for shark incidental catch (Bigelow et al. 1999). Swordfish sets are shallow while tuna are caught in deeper sets. In addition, some vessels use stainless steel wire leaders while others use monofilament. Depth of set affects species composition of shark incidental catch[9] and wire leaders result in higher catch rates (because sharks are less likely to bite through the leader and

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8Note, however, that American Samoa, CNMI and Guam are exempted from the Nicholson act. This allows foreign vessels to land and transship through these ports directly, as described above.

9Matsunaga and Nakano (1999), analyzing historic catches of sharks aboard Japanese research and training longline vessels, found oceanic whitetip and silky sharks were more commonly caught in shallow sets. However, they found no difference between CPUE of shallow and deep sets for blue sharks and the CPUE of thresher sharks on deep sets was greater than on shallow sets.

thus escape.) Overall, shark CPUE is about ten times higher in sets targeting swordfish in comparison to tuna targeted trip (see Figure 2). Aside from depth of set, this higher catch rate may be due to the fact that swordfishing occurs at generally higher latitudes, where blue shark are more abundant, in contrast to tuna fishing. Nonetheless, a higher percentage of sharks are actually finned on trips where tuna are targeted, about 85% versus 48% for swordfish target trips and 40% for trips so-called mixed trips where sets are made on both tuna and swordfish. Thus the nature of fishing operations, changes in strategy dictated by the target species' resource status, and the status of market demand for both target species and shark products influence the number of sharks caught and the number retained. In the past few years there has been an overall decline in swordfish landings in favor of trips targeting tuna.

As already noted, a few species comprise almost all of the sharks caught. Table 4 lists all shark species caught, based on observer data. Although relative catches cannot be accurately determined from these data (because observer effort does not match actual fleet effort), it is safe to say (as noted above) that the blue shark comprises the great majority of all sharks observed. Further, aside from blue shark, only the oceanic whitetip, bigeye thresher, and shortfin mako comprise more than one percent of the other observed species. In general, the blue, oceanic whitetip and silky shark dominate the pelagic shark community in the tropical and temperate Pacific (Bonfil 1994). It can be seen that at least 15 other species have been observed, but are caught in very low numbers.

Table 4: Observed shark species and reported (logbook) catches, average number and percent total for the five years from 1994

Common Name	Latin Name	Number	Percent
Blue shark	*Prionace glauca*	94,504	94.00%
Oceanic whitetip	*Carcharhinus longimanus*		
Other (unidentified) sharks		2,457	2.44%
Smooth hammerhead	*Sphyrna zygaena*		
Scalloped hammerhead	*Sphyrna lewini*		
Unid hammerhead	*Sphyrna spp.*		
Tiger	*Galeocerdo cuvier*		
Galapagos	*Carcharhinus galapagensis*		
Dusky	*Carcharhinus obscurus*		
White	*Carcharodon carcharias*		
Bigeye thresher	Alopias superciliosus		
Pelagic thresher	*Alopias pelagicus*		
Common thresher	*Alopias vulpinus*		
Unid. thresher	*Alopias spp.*		
Thresher sharks		2,266	2.25%
Shortfin mako	*Isurus oxyrinchus*		
Longfin mako	*Isurus paucus*		
Unid. mako	*Isurus spp.*		
Mako sharks		1,313	1.31%
Crocodile shark	*Pseudocarcharias kamoharai*		
Salmon shark	*Lamna ditropis*		
Silky shark	*Carcharhinus falciformis*		
Sandbar	*Carcharhinus plumbeus*		

Cookie cutter	*Isitius plodius* (or *brasiliensis*)		
Bignose	*Carcharhinus altimus*		
Total		100,539	100.00%

The Council has responded to the rapid growth in the longline fleet through a series of measures that have limited the total number of participants, in order to limit capacity and stem overcapitalization, and implemented closed areas to minimize interactions with protected species and gear conflicts between longline vessels and inshore trollers (see Section 5). Today there are 164 licenses under Council regulations, although only about two-thirds of the permitted vessels are currently active.

As McCoy and Ishihara (1999) point out, the most significant characteristic of the Hawaii fleet is that they preserve their catch with ice because the market demand is for fresh rather than frozen fish. Combined with the relatively small size (since vessels longer than 101 ft. are not allowed in the fishery in order to limit fishing capacity), this imposes significant constraints on these vessels in terms of processing, storing and preserving non-target species.

During fishing operations a mix of factors contributes to a decision as to whether a particular shark will be retained. Particularly active or "green" sharks may be cut loose or a skipper may decide that the crew is giving too much attention to boating and processing shark and this is interfering with proper handling of target species fish. Broader market factors--specifically, an increase in demand for shark fins in the early '90s--have contributed to the large increase in the number of fins retained. In Hawaii a small and apparently static market exists for meat from mako and thresher sharks. But, as already noted, blue sharks represent 95% of the fleet catch. Because of the physical characteristics and market value of this species, only the fin is retained. This is reflected in the figures cited above; the increase in fins retained come primarily from blue sharks. Since blue shark meat cannot be kept for more than a few days, given the practice of using ice, and no local market exists for it, there has not been a corresponding increase in the number of carcasses retained.

7.2.3.2 Hawaii-based nearshore bottom longline fishery

In 1998 one vessel operator started fishing in the MHI and NWHI using bottom longline gear, targeting coastal sharks. The vessel ceased operating in late 1999. Information from an observer report, based on a trip in September-October 1999, is summarized here[10]. Observer data indicate that the following sharks were caught on the trip: 684 sandbar (*Carcharhinus plumbeus*) (70% of the total number), 182 Galapagos (*Carcharhinus galapagensis*) (19%), 85 tiger (*Galeocerdo cuvier*) (8%), 20 grey reef (*Carcharhinus amblyrhynchos*) (2%) and 9 blacktip (*Charcharhinus limbatus*) (1%). Forty-six percent of all sharks were landed alive, but there is considerable variation in survival rate between species. Incidental catch was reportedly low and consisted of uku (*Aprion virescens*) and ulua (*Caranx ignobilis*). During the observer-

10. These data were provided by the NMFS Pacific Islands Area Office from an as yet unpublished preliminary draft report by a NMFS observer on the September-October 1999 fishing trip.

accompanied trip the vessel fished at Necker island, Gardener Pinnacles, St. Rogatien Bank, French Frigate Shoals, Nihoa Banks (all in the NWHI), and Penguin Bank (in the MHI). Thirteen out of a total 20 sets were made at Gardener Pinnacles on this trip. No more than two sets were made at any one of the other locations.

The fishing vessel used was a steel-hulled Gulf shrimp boat with two longline reels (main and back up) for setting the monofilament groundline. Shark abdomen meat was the primary bait, but on two occasions incidental catch was used in addition to shark as bait.

After landing, smaller sharks (sandbar, Galapagos, blacktip, grey reef) were headed and gutted, rinsed clean, lowered into the hold and hung to freeze. The larger sharks (Galapagos and tiger) were finned and bled in the same manner, then filleted into 4.5 to 13.6 kg (10 to 30 lb) fillets. The fillets were rinsed and placed into orange baskets to remove excess water and frozen. Fins from all sharks were kept "wet" in the freezer hold. Crew also saved the jaws, hides and gall bladders from tiger sharks. The latter were sold as a remedy for back pain. The catch from the observer-accompanied trip was offloaded onto a freezer container at Honolulu for transshipment to Asia. A total of 20,131 kg (44,380 lbs) of dressed shark and 3,370 kg (7,430 lbs) of fillets were landed. Information on the number of fins offloaded was not available.

7.2.3.3 US purse seiners landing shark products in American Samoa

US purse seine vessels fish throughout the tropical central and western Pacific between 130º E. and 150º W. longitude, gaining access to national EEZs based on licenses issued pursuant to a treaty between the US and FFA member countries. As a result, this fishery is not directly managed by the Council. Seiners target skipjack and yellowfin tuna, which are frozen and delivered to canneries in the region. In 1998 about 35 vessels were active and a third of these are owned by US canneries. The rest are mostly owned by family enterprises. Catch of target species for all US purse seiners operating in the WCPO was 144,424 mt in 1997 (Lawson 1998). Shark catch is not reported, but Lawson (1997) estimates that the US fleet catches 429 mt annually. (Note that Lawson's estimates for the US fishery, based on observer data, are considerably lower than Stevens' (1996) estimates for the entire purse seine fishery.)

Although sets may be made on either free swimming schools or those associated with a floating object, the trend since 1995 has been to make more sets on the latter. The increase is mainly due to the use of free floating fish aggregation devices (FADs) deployed by seiners. This is significant in terms of shark incidental catch because as Williams (1997, p. 11) notes, "sharks species, as with other large pelagic predators (e.g., billfish), are more prevalent in the vicinity of logs and other floating objects." Presumably they are attracted to the community of baitfish and predatory tuna that remain associated with an object for long periods of time. Williams (1997) presents data on CPUE by species for sets on free swimming versus log-associated tuna schools. The silky shark has the strongest correlation with log-associated schools in terms of CPUE ratio. Conversely, CPUEs for the oceanic whitetip shark, manta rays (Mobulidae) and pelagic stingray (*Dasyatis violacea*) are actually lower for sets on associated schools.

During fishing operations, once the seine has been pursed and hauled in so that a small volume is enclosed, fish are brailed into a large hopper on the seiner's afterdeck. As the fish are directed down chutes leading from the hopper towards brine tanks below deck (where fish are rapidly frozen), the crew pull out sharks and put them aside. At this point most are already dead, according to interviews McCoy and Ishihara (1999, p. 39) conducted with seiner crews. There is a high degree of awareness about conservation issues among US seiner owners and skippers (because of past conflicts related to porpoise mortality in the eastern tropical Pacific), but deck crews are usually not US nationals and may be less cognizant of conservation issues. In addition, the lowest paid members of the deck crew, frequently from the Philippines or a Pacific Island,[11] view income from shark fins as a valued supplement to their incomes. They are also willing to undertake the additional work necessary to process and preserve the fins properly. In sum, McCoy and Ishihara argue that there are three factors that determine the likelihood that a seiner crew will fin sharks: (1) the amount of other work demanding crew attention, (2) the presence of crew with experience in finning methods (typically Filipinos have the most experience in this regard), (3) the expected price for fins received in port.

7.2.3.4 Other domestic fisheries

Of the remaining domestic fisheries in the region, only the longline fleet in American Samoa is currently actively managed under the Council's Pelagic FMP. This is a relatively small fishery conducted mainly from 28-32 alia catamarans deploying a short (3-5 nm) longline with a hand-powered reel. Total landings in 1998 were 401 mt (see Table 3). Although a federal permit is required to participate in this fishery (pursuant to Amendment 2 of the Pelagic FMP), there are currently no limits on the number participants. To date 50 permits have been issued, but only about 15 vessels are active. Although the boats fish as far as 25 nm offshore, most effort is concentrated on shallow banks that lie 5-10 nm off Tutuila's south coast. The reported shark catch in 1998 was 3.26 mt (see Table 3).

Other domestic commercial fisheries that have some level of incidental catch include trollers, tuna handliners and bottom handliners in Hawaiian waters. Together these fisheries land, on average, about 5.5 mt of sharks per year. (It is important to note that this figure represents landings of shark carcasses; finning is not practiced in these fisheries.) However, HDAR staff believe that fishers may under-report shark catches. Reporting of non-target species by species tends to be poor but they probably catch a mix of coastal and pelagic sharks; common identified species in the troll fishery include mako, tiger, thresher and hammerhead sharks. In the bottom handline fishery thresher and tiger sharks constitute about 25% of shark catches. Pelagic handliners report catches of thresher sharks, and mako and tiger sharks to a lesser extent. It is important to point out that in these fisheries sharks are most often reported in a general category (e.g. "*mano*"), not by species or genus. The general "*mano*" category could include species that are caught more frequently than mako, tiger, thresher or hammerhead. No management measures have been imposed on these fisheries. Thus the Council currently has little latitude to either

11According to FFA data on the nationality of US seiner crews, Filipinos account for about 25% of the total and Pacific Islanders 15%.

determine the impact of these fisheries on shark populations or to regulate catch. In Guam and the Northern Mariana Islands small-scale commercial trollers catch small numbers of both coastal and oceanic sharks. Landings in 1998 are reported to be 3.6 mt for the Guam fleet; no commercial landings of sharks are reported for CNMI
(Pelagic Plan Team and Council Staff 1999). However, representatives from these areas have expressed interest in developing fisheries specifically targeting sharks at some future date. American Samoa has a very small troll fishery (many fishers have switched to longlining) with negligible shark catches, amounting to only about 0.2 mt or less annually.

Recreational fishers also catch sharks, but there is currently no regular program for collecting data about recreational catches in Hawaii. In Hawaii, and probably elsewhere, some component of the recreational catch is made by so-called "expense" fishers, or those who sell some proportion of their catch to cover operating costs. Technically, in Hawaii these are considered commercial operations but not all report their catch as such.

In sum, outside of the Hawaii-based longline fishery, and to a lesser extent purse seiners landing catch in American Samoa, shark catches and landings are poorly documented, but assumed to be low in comparison to the Hawaii longline fishery and US purse seiners (see Table 3).

7.2.4 Disposition of landed shark products and economic characteristics of trade

Worldwide a variety of products are derived from sharks including meat, tanned hides and shark liver oil (a source of vitamin A and industrial lubricants). However, fins are the most common product derived from sharks in the high-seas fisheries of the tropical Pacific. The ceratotrichia, commonly called fin needles, noodles or fiber, is a form of cartilage used in preparing an Asian delicacy, shark fin soup. Processing fins to extract ceratrotrichia is a laborious process. This processing may be carried out by specialists and/or in places with low labor costs. This contributes to the complexity, and inscrutability, of transactions in the trade. The quality of fin cartilage, and thus price, varies substantially between species of shark. Final market price is also influenced by venue; specialty restaurants can command a much higher price than less sophisticated settings. Demand for shark fin is correlated with rising incomes in Asia, and particularly in the People's Republic of China. At the same time, many smaller, less sophisticated restaurants have opened to meet demand at a lower price point. (This is possible because of the variety of fin grades, and thus prices, available to retailers.) As a result, Hong Kong, the worldwide center for the fin trade,[12] saw a steady rise in imports from the mid 1980's to 1995. The economic crisis in Asia, beginning in 1997, affected imports which fell from a high of 4,215 mt in 1997 to 3,723 mt in 1998 (McCoy and Ishihara 1999, p. 43). Exchange rate fluctuations affect relative price and thus the attractiveness of different sources of supply. In Hong Kong falling Asian currencies made supplies from within that region cheaper relative to

12Taiwan is an important consumer of shark fins but imports little product. Its own coastal and distant-water vessels supply the market and are protected by high tariffs. As a result, imports are not great: 0.3 mt from US-flag areas and 57.5 mt total (McCoy and Ishihara 1999.)

the US, since the Hong Kong dollar is pegged to the comparatively strong US currency. Fisheries in the Council region saw shark fin prices fall as a result of these factors. McCoy and Ishihara argue that the price change may have resulted in reduced finning rates in the purse seine fishery. The Hawaii longline fishery has continued to see an increase in finning rates however.

As a trade center, Hong Kong imports from all regions; the Mideast is a major transshipment point and ranks first as a source of fins with 700 mt coming from there in Jan.-Nov. 1998 (McCoy and Ishihara 1999, p. 46). In comparison, 105 mt came from Oceania during this period, with Australia accounting for 53 mt, or half the total.

In the US-flag areas of the Pacific local traders and agents provide the link between fishers and brokers in Hong Kong. For large-scale Hong Kong brokers establishing reliable and trusted contacts in source areas is paramount. But, as McCoy and Ishihara (ibid., p. 47) point out, "The distinction between trader, processor, and end user can be blurred in Hong Kong, Honolulu, or elsewhere as individuals can be active in all three sectors." Thus traders may also buy for a local restaurant that they own. The authors (ibid., p. 48) identify a total of nine active traders, three each in Hawaii, Guam and American Samoa, operating on a part-time basis. But, as indicated above, the Hawaii-based longline fleet is the only domestic fishery within the Council region producing substantial numbers of shark fins.

7.2.4.1 Hawaii

As already noted, there are two distinct sources of supply passing through Hawaii, Korean ULT longliners transshipping fins and the domestic longline fleet. Although information on practices aboard the Korean vessels is limited, McCoy and Ishihara (p. 36) suggest that sharks "will be at least finned, there is also the probability that makos are retained as they are on Taiwanese high seas longliners." Because vessels are relatively large and labor costs comparatively low, processing of sharks is viable. (Fins are apparently dried rather than frozen "wet" as is the case aboard some other high seas vessels with freezer capacity.) Further, they argue, the ability to sell to buyers and transship fins through Hawaii is the biggest incentive for high finning rates. It is difficult to know what proportion of shark meat is retained since none is transshipped through Hawaii. Because meat from mako sharks commands a relatively high market price in Japan, it is assumed that they are frozen aboard and shipped to Japan by reefer. McCoy and Ishihara found it difficult to estimate total volume and value of fins landed by the Korean fleet, but suggest an at-sea FOB price of $18-$20 per kg and estimate that roughly 132 mt of fins are shipped through Hawaii annually (see Table 5). The local economic benefits from these transshipments are very limited since no processing or sale occurs within the state. As noted above, local vessels are occasionally contracted to deliver fins to port for transshipment. Based on this and the local in-port costs (agency fees, storage, wharfage, etc.) McCoy and Ishihara (p. 92) estimate $235,000 in annual local expenditures related to transshipment from Korean ULT vessels. However, as noted above, resupply tankers servicing the fleet put in at Honolulu to purchase fuel and supplies, generating an estimated $9-$12 million. As the authors note, "If the transshipment of fins through Hawaii acts as a major attractant to the tankers that

collect fins in this manner, then consideration should be given to including all or a portion of the revenue from such business in the consideration of economic contributions from sharks."

Crew on Hawaii-based longline boats are usually instructed by buyers in shark processing methods (or they already possess this knowledge from experience in other domestic fisheries). Typically the dorsal, two pectoral, and lower caudal fins are removed and strung together as a set. The fins are sun-dried for three or four days and then stored in a warm, dry place such as the engine room. Sometimes other fins such as the small pelvic and anal fins, known as "chips", are also retained, but they command a much lower price. Crew on Hawaii-based longline boats are usually instructed by buyers in shark processing methods (or they already possess this knowledge from experience in other domestic fisheries). Typically the dorsal, two pectoral, and lower caudal fins are removed and strung together as a "set." Sometimes other fins such as the small pelvic and anal fins, known as "chips", are also included, but they command a much lower price. According to a Hawaii-based fin dealer, buyers prefer to purchase these sets, consisting of the marketable fins noted above, derived from the same shark. Fin sets take into account the variation in quality between the constituent fins. Aside from the only occasionally retained chips, for blue sharks the pectoral fins have the lowest value, the dorsal is intermediate and the lower caudal lobe the most valuable. (Figure 3 shows these different fin types.) These differences are due to the ratio of cartilage and recoverable fin needles in each type of fin. Discounts may also be applied for fins that are not thoroughly dry. While at sea fishers sun-dry the fins for three or four days and then store the sets in a warm, dry place such as the engine room. Sets are sold to the buyer at the dock on arrival in port. The aforementioned dealer assesses value based on the total delivered weight of fin sets since he has found that the proportional weight of constituent fin types is very consistent from set to set. Payment is almost always made in cash directly to the seller.

Table 5: Estimates of volume and ex-vessel value of shark fins landed in Hawaii, American Samoa and Guam, 1998 **(Source: McCoy and Ishihara, 1999).**

Location and source fleet	Estimated volume (dry fin weight, mt)	Average price range ($/kg)	Estimate range of ex-vessel value ($'000)
Hawaii-based longline	38	25-30	950-1,140
Hawaii transshipments	132	18-20	2,376-2,640
Guam: Taiwan longline transshipments	5-6	20-30	100-180
Guam: Japanese longline	18-28	10-13	180-364
Am. Samoa: longline	35-47	13-15	455-705
Am. Samoa: purse seine	9-10	18-23	162-230
TOTAL	**237-261**		**$4,223-$5,259**

McCoy and Ishihara analyze the importance of income from shark fin sales by vessel crews in the various fisheries that land or transship fins at US flag ports in the region. In the longline fishery crew members are paid a share, or percentage, of the proceeds from landings, based on their experience and position on the boat.

Based on a fleet survey, Hamilton, et al.(1996) report a combined mean captain and crew share of about 22%.[13] Shares are calculated based on gross revenue minus shared costs, which include fuel, oil, bait, ice, miscellaneous fishing gear, food, and excise taxes. The owner keeps a large proportion of the proceeds in part to cover other operating costs. Income from shark fins, in contrast, is only shared among participating crew so finning benefits them much more directly. The authors estimate that the annual average income (exclusive of the captain) at $25,000. Based on estimated total revenues from shark fins landed by the fishery, they estimate an average of $2,375 to $2,850 per crew member or 10%-11% of the estimated annual wage. They suggest that "owners may have an incentive to encourage finning as a salary supplement to crew members in order to contain crew costs" (p. 81). On some fishing trips targeting tuna, where the catch was especially poor, crew income from finning actually exceeded regular crew share. However, in interviews they found that attitudes varied; some owners opposed finning while others saw it as an essential component of crew compensation.

McCoy and Ishihara point out that the US mainland is probably an important market for fins landed in Hawaii since there is a significant and growing population of Asian-Americans there who could stimulate demand. Further, in US coastal shark fisheries shark quotas have been reduced, limiting domestic supply. Trade figures, or 'exports' of fins from Hawaii to the mainland are not available, but the authors note that imports of shark fins into the US have fallen since the early 1990's despite a robust economy and a presumably growing market. This suggests that domestic supplies, potentially including Hawaii, have taken a larger share of the market during this period. McCoy and Ishihara (p. 66) estimate that about 38 mt of dried shark fins are landed by the fleet; 95% are blue sharks and the remainder are mako (2%) and other sharks (3%). (This leaves out thresher sharks from which only caudal fin has any market value; in 1998 1,357 thresher sharks were finned.) At the market peak, in 1995, fins sold ex-vessel in Hawaii for $61-$66/kg. They subsequently declined to $25-$30/kg by early 1999. The overall economic impact of shark products landed or transshipped through US Pacific flag areas, as estimated by McCoy and Ishihara, is summarized in Table 6.

Hawaii longliners only retain thresher and mako shark carcasses for sale. According to logbook data, 471 mako and 145 thresher sharks were kept by the fleet in 1998. McCoy and Ishihara estimate that this would amount to a total dressed weight of around 31,500 kg, valued at $42,000 (p. 66-67). The meat from blue sharks, which represent the vast majority of sharks caught, is not retained. This is due to both physical and market constraints. The authors identify four crucial barriers to the retention of blue shark carcasses: (1) short storage life of the flesh in ice, (2) capacity constraints of Hawaii-based longline vessels, (3) limited deck space on these vessels necessary for proper handling, and (4) low value for the landed product.

Sharks have high levels of urea (or more generally, non-protein nitrogen--NPN--compounds) in their flesh because of their primitive excretory and osmoregulatory system. When

13They report highliner shares separately from other fleet vessels. Crew and captain highliner share is 21.5% and on other vessels it is 22.6%.

the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. Blue sharks are especially high in NPN compounds, compounding the difficulty of processing and preserving their flesh. In order to avoid this problem, sharks should be landed alive and rapidly bled in order to remove as much of the NPN compounds as possible. Work spaces have to be kept clean in order to avoid re-contamination due to blood-borne urea contaminating ice. Blue sharks need to be further processed aboard the vessel in order to remove still more urea. Even after careful processing blue shark meat can be held on ice for no more than five days before spoilage sets in. (This contrasts to frozen shark, which may be held for up to five months.) These characteristics contribute to the first and third constraints outlined above.

Table 6: Summary of direct economic contribution of sharks to local economies ($'000)
(Source: McCoy & Ishihara, 1999)

Item	Hawaii	Guam	American Samoa	Total
Crew spending from shark fin revenue	950-1,140	180-364	422-653	1,552-2,157
Fresh shark meat sales	42	-0-	-0-	42
Local transshipment expenses	235	53	-0-	288
Trader gross margin	332-399	54-109	123-187	509-695
Direct government revenue	-0-	-0-	7	7
TOTAL	**$1,559-1,816**	**$287-526**	**$552-847**	**$2,398-3,189**

Hawaii vessels are also capacity constrained on several levels. First, even if sharks could be held using current ice-chilling methods, the total space available is limited and priority will always be given to much higher valued target species. Ice is also a limiting factor, except for vessels carrying ice makers. Thus by the same token, operators are unwilling to devote significant amounts of ice to chill and hold low value non-target species. In theory, and depending on their design and construction, existing vessels could be refitted with freezer holds specifically for shark carcasses. However, since market conditions demand a fresh product for target species, ice storage would have to be retained. Given size limits on the vessels, a second level of capacity constraint would be encountered to the degree that freezer holds supplants ice storage.

Clearly the fourth constraint, low market value for blue shark meat, is an overarching factor. Fundamentally, the costs involved in handling, processing, preserving and landing blue shark meat currently far outweigh the revenue that might be garnered from doing so. In fact, there is currently no established market for blue shark meat in Hawaii. But it is important to note that in Japan and Taiwan markets do exist, supplied by coastal fisheries or frozen product. However, blue sharks are usually further processed in that they are used to produce kamoboko.

Artisanal fisheries in Southeast Asia also occasionally retain blue sharks. In Mexico a significant market for blue sharks exists, supplied by coastal fishers in Baja California and frozen product from Japanese high-seas vessels. Spain also consumes a large amount of shark (of which an undetermined, but presumably high percentage, is blue shark) derived from Atlantic fisheries. A large proportion of these products also involve further processing, as either dried, smoked or pickled product (Kelly 1999b). In all of these markets prices in general are low. McCoy and Ishihara (p. 59) review prices and found the highest prices, about $3.74/kg ($1.70/lb), reported from the Tokyo Central Wholesale Market; but this price represents only the highest quality from throughout the country and is not ex-vessel. In Mexico ex-vessel prices range from $0.35 to $0.95/kg. This compares unfavorably with target species prices, which ranged from $4.80/kg for swordfish to $7.08/kg for bigeye tuna.

7.2.4.2 American Samoa, Guam and CNMI

As in Hawaii, foreign vessels transship shark products through other Pacific US-flag ports. Of US domestic fisheries or flagged vessels, only purse seiners delivering to American Samoa land an appreciable quantity of product. In Guam Japanese longliners transship dried fins while Taiwanese longliners deliver frozen ("wet") fins and dressed carcasses (McCoy and Ishihara 1999, p. 68). Because these vessels fish outside the US EEZ and are transshipping (as opposed to landing) product, local authorities do not collect catch and landing data. This made it difficult for McCoy and Ishihara (ibid.) to estimate shark landings for these vessels, but they suggest that Japanese longliners transshipped 18-28 mt valued at $185,000-$364,000 and Taiwanese vessels transshipped 4.8-6.1 mt of dry fin equivalent. The authors estimate ex-vessel value at $180,000-$364,000 and the total direct contribution to the local (Guam) economy at $287,000-$526,000, based on Japanese crew spending of shark fin revenue, transshipment expenses, and local traders' revenues (see Table 6).

Local fishers in Guam and the Northern Mariana Islands may catch relatively small numbers of sharks but few are landed because there is no local market for shark meat. As discussed above, this situation could change if a local fishery targeting sharks is developed. Although there are fin buyers on Guam, local fishers are not apparently delivering to them.

US purse seine vessels landing fish in American Samoa most commonly catch silky and oceanic whitetip sharks. These "brown" species command higher prices than blue sharks. In addition, careful processing by seiner crews adds value so that these fins command a higher price of $18-$23 per kg (see Table 5). As on Hawaii longiners, seiner crews are paid a share the of landings revenue but keep all returns from the sale of shark fins. Further, there can be a long delay in receiving share income because the vessel does not receive payment until fish have been completely processed by the cannery, which may be several months after the fish are delivered. In contrast, proceeds from shark fins are received immediately, 'at the dock,' when the local trader purchases them. This is a further incentive since its provides the crew with spending

money. McCoy and Ishihara (p. 75) estimate that annual dried[14] shark fin landings by seiners at American Samoa are between 9.1 and 10.6 mt. Based on this figure total revenue in 1998 is estimated to be $162,000-$230,000 (p. 87). On a per crew basis this works out to $578-$821, or 4%-10% of total income.

Taiwanese longliners also sell shark fins to local buyers. A general problem in estimating volumes is that American Samoa levies a 5% duty on locally sold shark fins. According to McCoy and Ishihara this tax is widely circumvented, resulting in general under-reporting of landings. In addition, vessels also call at other regional ports, such as Papeete and Levuka, or to reefers on the high seas, and may offload only a portion of their shark fin landings in American Samoa, depending on prices. The authors believe that fins are landed "wet" but calculate a dry equivalent of 35-47 mt landed in 1998 valued at $455,000-$705,000 and estimate the total contribution to the local economy between $522,000-$847,000 (see Table 6).

7.2.5 Summary

The Hawaii-based longline fleet, both because of the volume of total catch relative to other fisheries and high incidental catch rates, catches the largest number of sharks of all Council-managed fisheries (see Table 3). The only other domestic fishery landing significant amounts of sharks are purse seiners calling at American Samoa. Blue shark is the main species caught in longline fisheries throughout the western Pacific (Lawson 1997; Williams 1997), and this is the case in the Hawaii fishery as well. McCoy and Ishihara estimate the total contribution to the economies of Hawaii, Guam and American Samoa at between $2.4 and $3.2 million. Hawaii has the highest share of this amount, 61%. The volume and value shark fins from high seas ULT longliners transshipped through Hawaii is greater than the volume and value of shark fins landed by any of the domestic fisheries in the Council region (see Table 5). These foreign vessels are not directly subject to NMFS regulations, although domestic transshipment activity could be. Of the various foreign and domestic fisheries considered here, the Hawaii-based longline fishery ranks second in terms of shark landings at US ports in the region. Because of this relatively large catch volume, Council recommendations focus primarily on this fishery. And since blue sharks comprise most of the shark catch, concerns are directed at that species. (Although purse seiners also catch significant numbers of sharks, the Council does not have direct management authority over that fishery.) The other main cause of concern is the bottom longline fishery that was conducted in the NWHI in 1998-99. Although currently defunct, management regulations need to be considered in the event that interest in this fishery revives.

8 Management Issues and Objectives

The preceding discussion indicates that there are a range of issues relating to the catching and using of sharks in Council-managed pelagic fisheries. These issues are identified here and objectives that address these issues are outlined.

14Some seiners deliver fins frozen, or "wet." The authors apply a conversion factor to arrive at an equivalent dry weight.

8.1 Issue 1: Data on exploitation may be inadequate and/or inaccurate

Objective 4 of the Pelagic FMP is to improve the statistical base for conducting better stock assessments to support management and conservation of management unit species. Since sharks, as non-target species in WCPO fisheries, are not as accurately monitored as target species, the accuracy and detail of catch information is generally poor in non-US, high seas fisheries. Further, sharks that are caught may already be dead but are often discarded. These discards may not be reflected in catch statistics and make dockside verification of total catch impossible because discards are not landed. This suggests that there is a high likelihood of under-reporting in non-US fisheries. Logbook data and similar forms of self-reporting record all shark catch in a single, or at most a few, categories. In this regard, the Hawaii-based longline vessel logbooks provide greater detail since sharks are reported by number caught in four categories (blue shark, mako shark, thresher shark and other shark species) and disposition is also recorded (fins only, kept whole, and not kept/released). Domestic transshipping vessels are also required to maintain logbooks documenting transported product. (Reporting categories for shark are blue, mako, and fins, which are not identified by species. Numbers are recorded for carcasses but only total weight of fins is recorded.) Fishery observer data provides a greater level of detail and accuracy as well as a source of independent verification. However, since observer coverage is usually low, and non-existent in some fisheries, extrapolation to estimate total landings has some level of inaccuracy. Here again, the Hawaii longline fishery has a fairly good data set. It is important to remember that Council-managed fisheries are not alone in fishing on pelagic stocks. As already noted, ULT longliners from several nations fish in the North Pacific. As a high-seas fishery there is no coastal state that can require observer coverage. Korean and Taiwanese governments do not sponsor formal observer programs for flagged vessels, so shark catches cannot be independently verified. However, some level of monitoring occurs through efforts such as a SPC program, which places observers on high seas vessels on a voluntary basis.

In the Hawaii longline fishery shark catches for the few species that comprise the majority of the catch are accurately monitored. However, species that may have a very low natural abundance, and thus occur infrequently in catches, are not reported by species. Thus there may be insufficient information in order to determine whether fishing is having significant impacts on these species.

Although there may be advantages to codifying reporting requirements, they may be revised through administrative processes. The Council thus decided not to consider regulatory changes to reporting requirements but rather to encourage NMFS to implement non-regulatory actions to improve monitoring, as deemed appropriate.

Objective: Ensure that assessment and monitoring methods are sufficient to support management (using administrative means).

8.2 Issue 2: There is concern that the current level of pelagic shark exploitation is unsustainable

Objectives 1 and 2 of the pelagic FMP are to manage MUS for optimum yield (OY) and, within OY constraints, to promote recreational, traditional and commercial fishing opportunities. Because of the reproductive biology and population characteristics of sharks concerns have arisen that world-wide shark catches may not be biologically sustainable. However, as discussed in Section 7.1, there has been a tendency to generalize about the vulnerability of shark populations while in fact different species have different capacities for natural rebound. According to an analysis by Smith, et al., (1998, p. 673), "the more oceanic species with mid-range r_{2M}-values [population productivity] should be better able to withstand fishing pressure than their late-maturing coastal counterparts." All of the main species exploited by the longline fishery fall into this category. Further, the review of the current status of stocks outlined in Section 7.1.2 concludes that there are no obvious indicators of stock depletion for the main shark species caught in the longline fishery. Catches in other Council-managed fisheries are not considered large enough to have a significant impact on the stocks. However, as stated above, it is difficult to accurately determine the total catch on WCPO, and particularly North Pacific, shark stocks. This suggests that the Council should take a precautionary approach.

A related concern is that sharks may be 'keystone predators.' That is, that if they are removed from the ecosystem in significant numbers, existing trophic relationships may be upset, affecting other species' stock size or viability. Recent research involving ecosystem modeling of the central Pacific suggests that sharks are not keystone predators (Kitchell et al. 2000). However, the authors caution that an "increase in longline fisheries can have profound effects on the food webs that support sharks."

Regionally, there are few limitations on catching and landing sharks. A recent volume presents case studies on shark fisheries around the world (Shotton 1999). Where sharks are target species, as one might expect, a variety of management measures have been implemented. These include gear restrictions, quotas, prohibitions on landing certain species and prohibitions on finning. Size limits for sharks are rarely used although gear restrictions such as mesh size act to minimize catching small fish. A maximum size restriction is employed in Victoria, South Australia, but this relates to concerns about mercury concentrations in the flesh (Walker 1999). There are currently no regulations limiting the take of sharks in the high seas fisheries of the Western Pacific, of which longlining is a major component. Williams (1997), reviewing management in WCPO fisheries, identifies the need for continued research leading to better stock assessments, international cooperation (since distant water vessels fish in the waters of many Pacific Island nations) and a better understanding of the market structures for shark products.

Finally, it should be noted that the State of Hawaii may implement regulations covering the catching, processing and retaining of sharks. Such regulations would apply to State waters only (0-3 nm). However, the Council will implement complementary regulations for the MHI longline prohibited area (50 CFR 660.26(c)) and the NWHI longline protected species zone (50 CFR 660.26(b) and 660.12) waters under its jurisdiction around Hawaii for the Hawaii-based longline fishery.

Objective: Ensure that exploitation in Council-managed fisheries, including incidental catch of sharks, is sustainable.

8.3 Issue 3: The public is concerned about (1) the low product recovery rate from shark finning, which is perceived as wasteful; and, (2) the impact of catches on the "existence value" of sharks, which is important to some members of the public

Both the IPOA-SHARKS and the Council's Pelagic FMP emphasize that waste should be minimized. Objective 6 of the FMP is to preclude waste of MUS resulting from fishing operations. It is easy to see why finning is considered wasteful, since only a small portion of the shark is retained (less than 5% of round weight). However, as discussed in Section 7.2.4, there are serious impediments to the utilization of the most commonly caught shark species, the blue shark. This is reflected in the fact that if a product recovery rate for blue shark is calculated based on landed value, fins represent 72% while the meat represents only 3% (WPRFMC 1999, p. 18). Although not a target species, sharks are clearly "economic discards," defined by the Magnuson-Stevens Act as fish "which are not retained because they are of an undesirable size, sex, or quality, or for other economic reasons." This contrasts with target species, such as tuna, where the meat represents 91.5% of the total value of the fish. From the standpoint of economic efficiency the rationale for full utilization is thus less clear. Because of vessel capacity constraints, any measures that require a higher product recovery rate would most likely function more like a quota: given a choice between discarding the shark or retaining a significant proportion of the carcass, in most cases fishermen would choose the former, at least for blue shark. (The carcasses of marketable shark species, in contrast, are retained, depending on capacity constraints. For example, 1994-98, on average, 42% of mako sharks were landed as whole carcasses.) Even if fishermen were to retain blue shark carcasses (or a higher percentage of the fish's round weight), they would likely simply dispose of the carcasses on shore since there is no market for the meat. One could draw an analogy from agriculture to point out the complexity of the issue of waste. Only a small proportion of many food plants are edible or marketable. For example, much of a corn plant may be left in the field, or plowed under. However, this has a beneficial impact on the production system by providing nutrients for the next crop. More to the point, there are other marine organisms, such as the scallop or sea urchin, that have low product recovery rates because the value is confined to a small part of the organism. But because these animals are invertebrates, and thus the absolute amount discarded from each individual is small, and the part discarded is more obviously inedible, utilization is uncontroversial. It is clear that any efforts to minimize waste must address the demand side in conjunction with any measures, such as mandating retention of the carcass, that affect supply. Lacking a market for required landings, blue sharks would likely be disposed of in landfills, which is seen as more ecologically damaging and wasteful than returning them to the ocean ecosystem. As in the agriculture analogy, disposal at sea is better because the carcass is 'recycled' as a food and nutrient source in the ocean environment.

Several concerns are categorized under the term "existence value," in that they have less to do with sustainable use than with the continued existence of sharks, both individually and as a

species. In other words, the public may place an intrinsic value on sharks for cultural, ethical or aesthetic reasons that are not related to the physical consumption of sharks. Sharks may have symbolic value, as a unique life form similar to marine mammals, such that concerns about killing them supercede issues of sustainable use. For some people they may be considered "charismatic megafauna" similar to African big game and should be protected from exploitation for reasons intrinsic to the shark's nature. Further, the taking of fins may be seen as unnecessarily inhumane, especially if it is thought that this results in a lingering death because sharks remain alive afterwards. However, observer reports indicate that 98% of all sharks boated alive are killed before being finned. Finally, in the past Pacific Islanders frequently expressed relations with other organisms in kinship or mystical terms. In native Hawaiian cosmology, for example, sharks could be an *'amakua*, or *'unihipili*. The first is a beneficent guardian spirit and the latter a spirit under the control of a sorcerer. McCoy and Ishihara (1999, pp. 99-103) briefly review past and contemporary beliefs among indigenous people in the US-flag Pacific Islands. They note that most of the knowledge about which shark species may have been spiritually important to Hawaiians has been lost. It also seems likely that few, if any, native Hawaiians maintain the same type of relationship to sharks as did their ancestors. Nonetheless, many native Hawaiians are seeking to revive or maintain a distinct sense of cultural identity. Non-native Hawaiian exploitation of sharks can thus be an issue. The authors quote two statements by native Hawaiians emphasizing a contemporary recognition of sharks as *'aumakua*, even if the precise relationship differs from that of the past. Although a spiritual relationship, like that native Hawaiians once held, does not appear to be an aspect of contemporary culture in any of the other US-flag islands, the authors do note that non-commercial use of sharks, within a context of indigenous practices and mores, continues in American Samoa.

Objective: Minimize waste and recognize the existence value of sharks to the extent practicable within economic constraints.

8.4 Issue 4: Bottom (demersal) longlining does not fall under current regulations and may have adverse impacts on protected species and easily deplete target species

The current regulatory definition for longline gear describes it as "...consisting of a main line that exceeds 1 nm in length, ... suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached..." The bottom longline gear described in Section 7.2.3.2 does not conform to this definition because the main line is not suspended in the water column but rests on the bottom. Thus there are no existing measures that may be used to manage this type of fishery. This makes it difficult or impossible to satisfy FMP objectives, particularly objective 1, to achieve optimum yield for management unit species.

Although this fishery is not currently active, regulations should be in place to deal with it in the future should it be reactivated. The Bottomfish Advisory Panel voiced a range of concerns about this method, including the potential for endangered and protected species, especially the endangered monk seal (*Monachus schauinslandi*), to be harmed by the gear. Other concerns included possible impacts on essential fish habitat and habitat areas of particular concern,

infringement on native use rights, problems resulting from lost gear, gear conflicts and the possibility that sharks might be attracted closer to recreational use beaches. In addition, the main target species, the sandbar shark (*Carcharhinus plumbeus*), may be easily depleted; Smith, et al., (1998) categorize it among the more vulnerable slow-growing, late-maturing sharks.

Before any management measures can be implemented, this fishing method must be identified and defined in management regulations. It is important to tailor regulations specifically for bottom longlining since representatives from Guam and CNMI, in contrast to Hawaii, indicated that there is some interest in establishing a shark fishery there, especially since sharks are thought to affect existing fisheries by predating on hooked target species.

Objective: Regulate bottom longlining to prevent adverse impacts on protected species.

8.5 Issue 5: Pelagic management unit species (PMUS) definitions for sharks are not species specific and thus many species rarely or never caught in pelagic fisheries are nonetheless part of the management unit.

As noted in Section 7.1, shark MUS are defined broadly in the Pelagic FMP. Currently species that are members of Alopiidae, Lamnidae, Sphyrnidae or Carcharhinidae are pelagic MUS. Although the Pelagic FMP states that "the management unit species occupy a pelagic environment during all stages of their lives" (WPRFMC 1986, p. 6-1), this is not reflected in the regulatory definition. This means that shark species rarely caught in pelagic fisheries, but occasionally caught in other Council-managed fisheries, fall under pelagic fisheries regulations. Management would be more effective if shark MUS were specifically defined and primarily coastal species reassigned to other management plans.

Objective: Manage sharks under appropriate fishery management plans for each species or species group.

9 Management Alternatives

In order to address each of the objectives outlined in Section 8, the Council considered several management alternatives and chose a preferred alternative for each. The alternatives are described below. The reasons for choosing the preferred alternative and rejecting the other alternatives are discussed at the end of each subsection.

9.1 Alternatives considered to ensure that exploitation in Council-managed fisheries is sustainable

9.1.1 Alternative 1 (Preferred). Implement a precautionary annual harvest guideline of 50,000 blue sharks that may be landed by the Hawaii-based longline fishery and 1 shark of any other species per trip (landed with carcass).

Because our knowledge of shark biology is limited, and total fishing mortality on stocks is not closely monitored, the Council favors establishing an annual harvest guideline[15] on the number of sharks landed in the Hawaii longline fishery as precautionary measure. An initial value of 50,000 blue sharks (*Prionace glauca*) that may be retained, and thus contribute to fishing mortality, was chosen as an approximation of 1996-1998 average annual landings of 51,312. As noted, although other shark species represent a very small proportion of total shark catches, little is known about their abundance or vulnerability to overfishing. Thus, although caught in low absolute numbers, there is a possibility that stocks are threatened. For this reason, a separate harvest guideline is proposed for all other non-blue oceanic sharks of one non-blue shark per fishing trip. Further, it is recognized that a market exists for the flesh from these sharks (unlike blue sharks); for this reason these sharks would have to be landed whole (or as whole dressed carcasses), rather than simply finned. Recognizing that blue sharks are normally finned (since there is no market for their meat), for monitoring and enforcement a proxy must be used to determine the number of sharks the landed product represents. This could be either landed fins, or weight, from which numbers of sharks can be estimated with reasonable accuracy. Dealers prefer to buy shark fins in "sets," which consist of the lower caudal fin, the two pectoral fins, the dorsal fin, and occasionally, the anal fin from the same shark. However, according to one Honolulu-based buyer, individual fins are not separately counted. Instead, they are received in sets and weighed in aggregate. One pound of dried fin per blue shark is an accurate average weight which could be used for monitoring purposes. Therefor 50,000 lbs of dried fins would represent the annual quota of 50,000 sharks. An alternative would be to use the number of fins, or shark fin sets for monitoring and enforcement purposes. As noted, one set would equal one shark landed for the purposes of the harvest guideline. Another approach is to count numbers of a specific type of fin, thus if expressed as the number of caudal fins (the most highly valued fin on a blue shark), 50,000 of these fins would be equivalent to the harvest guideline since each shark has only one of these fins. This would necessitate enforcement officers distinguishing between types of fins and counting the appropriate type.

In addition, a framework adjustment process, implemented in Amendment 7, can be used to revise the harvest guideline as scientists gain more knowledge about stock abundance and changes in abundance can be more precisely monitored. If it is determined to be necessary, additional species-specific quotas could be set. Observer data on species of sharks that are caught (see Table 4) can be used to cross-check and expand logbook reporting in a manner similar to current methods used in estimating the marine turtle incidental catch. This would allow the application of more detailed, species-by-species quotas. The framework process established under Amendment 7 describes how "established measures" may be changed without resorting to the FMP amendment process (pp. V-4 to V-12). Since this amendment establishes a harvest guideline, a change in harvest guideline number, or even a modification to establish further species-specific quotas, would be considered an "established measure." As noted in Amendment 7, "An adjustment [to an established measure] must be consistent with the original purpose of the

15Harvest guideline is defined in regulations as "a specified numerical harvest objective" (50CFR660.12). It is equivalent to a fishing quota but harvest guideline will be used in preference since it has regulatory meaning.

measure being adjusted and the impacts of the adjustment must be within the range of the impacts considered when the measure was fist proposed and implemented" (p. V-4).

The procedure for changing established measures is laid out in Amendment 7 and is summarized here (also refer to 50 CFR 660.31(b-c)):

1. The Council identifies a problem that warrants action. (For example, additional data indicate that current shark catches, or catches of certain species, are unsustainable). This is reported in the annual report prepared by the Council-appointed Pelagics Plan Team by June 30 of each year. A problem may also be identified in a separate report by the Plan Team, Advisory Subpanel, Pelagics Review Board, enforcement officials, NMFS, concerned pelagic fishers or other sources. (A variety of data types are identified in Amendment 7 that could indicate and support further investigation of a perceived problem.)

2. The Council considers a variety of measures to address the problem and at their next meeting decides whether an adjustment should be made. The notice to the public and news media preceding the meeting would indicate that the Council intends to discuss and possibly recommend regulatory adjustments through the framework process. The public notice would summarize the issues and the original basis for setting the regulation being reviewed and would refer interested parties to relevant documents.

3. Based on discussions at the meeting (including input from advisory bodies) the Council decides whether to recommend action to the Regional Director (RD). If a recommendation is made, they ask the RD to indicate any concerns or objections to the recommended action or actions and how they may be addressed.

4. If the Council proceeds with the adjustment, then a framework adjustment (or regulatory amendment) document is prepared. These documents are similar in format to an amendment document, but should demonstrate how the proposed adjustment is consistent with the purposes of the established measure being modified.

5. If the RD approves the Council's recommendation, the Secretary is expected to waive for good cause the requirement for prior notice and comment in the Federal Register and would publish a "final rule" in the Federal Register, which would remain in effect until amended. However, the Secretary may provide additional opportunity for prior notice and comment, if deemed appropriate.

6. If the proposed adjustment is disapproved in whole or in part, the RD provides an explanation of the reasons for disapproval and makes recommendations to resolve these problems. A revised proposal is treated as if it were a new proposal, but earlier consideration by the RD makes implementation more likely.

The anticipated date at which the harvest guideline would be reached--the 'closure date'--would be initially calculated based on fishing patterns during the previous year. This anticipated closure date, after which sharks (or parts thereof) could no longer be retained by Hawaii-based longline vessels, would be announced by NMFS early in the calender year to make it easier for fishers to plan their trips. While at sea, Hawaii-based longliners would then have to regularly report, via radio, how many sharks (based on any part thereof, such as fins) they had retained on board. The frequency of these reports would likely have to increase as the anticipated harvest guideline date neared. This reporting could be based on the information contained in existing logbooks since currently the number of sharks, in four categories, both caught and retained must be entered. However, catch and retention data might have to be tabulated more frequently for the purpose of at-sea radio reporting. In addition, landing reports for sharks or shark parts would have to be cross-checked with these at-sea reports. Throughout the year, up until the closure date, NMFS would regularly appraise fishers of changes in the closure date, based on at-sea reports. Fishers would have to plan their trips so that they returned to port and landed shark products prior to the closure date or did not retain sharks on a trip that was anticipate to overlap the closure date.

9.1.2 Other alternatives considered

Alternative 2. Prohibit the retention and landing of shark products in all Council-managed fisheries and the domestic transshipment of shark products through US-flag Pacific ports.

This alternative would essentially prevent the utilization of sharks caught in any Council-managed fishery. It would have a limited impact on shark finning by foreign vessels since they may transship directly through American Samoa, CNMI and Guam (due to a Nicholson Act exemption) and their fishing activities outside the US EEZ cannot be regulated by the Council. Only transshipment through Hawaii, since it is effected by US-flag vessels, would be affected. Since sharks have a comparatively high survival rate when caught by the main gear types used in the region (longline and troll), this alternative would have a substantial impact in reducing fishing mortality, at least for domestic fisheries. It is less clear whether a transshipment prohibition would deter foreign vessels from finning sharks since they may find other methods of getting the product to market.

Alternative 3. Prohibit the retention and landing of shark products by the Hawaii-based longline fishery.

The Hawaii longline fishery catches the great majority of all the sharks caught by Council-managed fisheries. Thus this alternative represents a more restrictive version of the first (preferred) alternative. It recognizes that the other Council-managed fisheries currently land few sharks so there is no pressing rationale for regulating their take and that, as discussed above, the effect of a transshipment ban would be limited to domestic vessels currently transshipping fins through Hawaii, which receive from foreign vessels on the high seas.

Alternative 4. Implement an annual quota based on some other measure than the number of landed sharks or sets of fins (e.g., weight).

An alternative to a quota based on the number of landed animals would be one that used the weight of landed shark products to calculate the total round weight of sharks caught. This would be somewhat easier to monitor at dockside since determining weight is a simpler process. However, some research would be required to determine an appropriate conversion factor to determine round weight. In addition, change in the average weight of sharks caught in the fishery would have to be determined independently and such changes can have implications for stock status. If average weight diminishes the same weight-based quota can result in higher mortality. This is a problem with shark management on the US Atlantic coast (Branstetter 1999, p. 128). The problem would be further complicated by the low product recovery rates inherent in finning. Back calculation to round weight, and then to the number of animals, would be subject to inaccuracy since the recovery rate varies due to processing method and a small discrepancy between applied and actual recovery rate would result in a cumulatively large error in round weight estimation. It is true that the number and disposition of sharks caught are already recorded in longline logbooks, providing another source for monitoring numbers. But correlating landed weight and logbook numbers, in order to ensure compliance, would be subject to the same set of uncertainties just outlined.

A numeric quota based on the number of sharks caught (but not necessarily landed) and killed in the fishery, thus including sharks that die on the longline before being brought to the gunwale, was also considered. This type of quota would have the advantage of more accurately reflecting total fishing mortality by taking into account dead but not landed sharks. However, ensuring compliance would be difficult without observer coverage on all vessels. In any case, a quota based on landings can be adjusted to take this additional source of fishing mortality into account. If deemed necessary, the quota can be reduced appropriately by applying an average figure for un-landed dead sharks to approximate total fishing mortality.

Alternative 5. Implement minimum and/or maximum size limits for retained sharks based on reproductive characteristics of different shark species or prohibit the taking of all female sharks.

As outlined in Section 7.1, concern of the vulnerability of shark populations to overfishing stems from the intrinsically low reproductive rates and long period to sexual maturity for many species of sharks. Smith, et al., (1998, p. 671) argue that size limits afford “protection at least during the peak reproductive years ... based on the size at which females first reproduce and the size at which fecundity declines with senescence or beyond which further survival is low.” Nakano (1994) estimates that 50% of females are sexually mature at 140-160 cm precaudal length (180-212 cm total length) and that both sexes are sexually mature at 150 cm precaudal length (199 cm total length). Setting a size limit of 150 cm precaudal length would reduce fishing mortality on sexually mature blue sharks. A more cautious approach would prohibit the taking of all female sharks. However, Smith, et al., offer this management alternative in the

context of slow-growing, late maturing shark species. The main species caught in the longline fishery are less vulnerable species. Monitoring compliance with a size and/or sex-based approach to management would be difficult. With continued finning, determining compliance based on landed product would be difficult or impossible.

Alternative 6. Require more selective gear and/or minimize mortality of released sharks

This alternative is in fact a complimentary to the preferred alternative and also addresses some of the concerns outlined under Issue 3. The most straightforward measure would be to prohibit the use of steel leader, currently used on a minority of longline vessels. Sharks can escape more easily from monofilament equipped gear since they often bite through the line. By the same token, a prohibition on steel leaders could result in a lower catch rate for target species. From the available evidence the retention of hooks by escaped sharks (as long is they are not swallowed) does not significantly affect survivability (McCoy and Ishihara 1999, p. 111). McCoy and Ishihara (ibid., p. 112) outline possibilities for gear improvement:

> Some candidates for research could be the color, placement and frequency of lightsticks used in the swordfish fishery, the exclusive use of monofilament leaders in the tuna fishery, and the types of hooks used in both. There may be existing electronic equipment, such as the "down temp" temperature and depth sensor that has been used in the east coast longline swordfish fleet, that may be applicable to Hawaii-based vessels to help avoid areas where environmental conditions would have a greater tendency to congregate sharks.

Some research of this type has been conducted in Hawaii (Boggs 1992). Relevant work to reduce shark bycatch has also recently been reported from elsewhere. Erickson and Berkeley (2000) report that a reduction in gear soak time significantly reduces bycatch and bycatch mortality while not having a major impact on catch rates of target species. The authors also report on the use of artificial bait tested in Alaskan demersal longline fisheries. Although developed as a cost-effective way to increase target species' catch rates, shark bycatch declined remarkably when this bait was used. It may be possible to develop artificial baits for pelagic tuna and billfish fisheries that have similar effects. But more work is necessary before gear changes that would substantially reduce shark catches can be mandated. Continued research and education are better near term strategies to effect changes in gear design and fishing strategy, rather than requiring immediate changes by regulation.

Alternative 7. No action

9.1.3 Reasons for choosing the Preferred Alternative and rejecting the other alternatives

The discussion of stock status outlined in Section 7.1.2 suggests that blue sharks are not being over-exploited. As described in Section 7.1.2, Matsunaga and Nakano (1999) did not find a decrease in CPUE for blue shark and infer that "the abundance of blue shark did not show any remarkable change ... from 1968 to 1995, and at least did not decrease" (p. 21). Thresher shark

CPUE increased. Blue and thresher shark species comprise a great majority of the total number of sharks caught in the longline fishery. Smith, et al., (1998) argue that oceanic sharks, including all of the main species caught in the Hawaii longline fishery, are better able to withstand fishing pressure due to relatively high rates of productivity. However, they caution that

> ...these species are also among the most marketable and vulnerable to the extensive and productive oceanic fisheries, which sustain high exploitation rates. In addition, there are insufficient data with which to adequately assess the extent of this direct and incidental harvest, no regulations or requirements for reporting the shark by-catch in the Pacific oceanic zone, and little monitoring or management of the by-catch in the Exclusive Economic Zones of most countries. (p. 673)

As noted, the best available data may underestimate total fishing mortality on shark stocks. Although a ban on landing sharks would be the most conservative approach, the Preferred Alternative is a prudent alternative since it allows a level of exploitation that is considered sustainable. This is in line with the first two objectives of the FMP, which call for optimum yield management of MUS while promoting fishing opportunities. Thus it represents a cautious approach that does not have an immediate and undue impact on fishers' incomes. The first two rejected alternatives, variations on a total prohibition, are not merited given what is known about shark stocks. Income from finning supplements crew income and the total impact of economic activity related to shark finning in the region is not inconsiderable, estimated at $2.4-3.2 million. It is unclear whether a prohibition on transshipment would affect foreign fishers, who catch much greater numbers of sharks than do US domestic fisheries in the region. McCoy and Ishihara (1999, pp. 93-94) outline alternative ways of getting fins to market if transshipment through US ports were prohibited. Quotas based on some other measure than the number of landed sharks (Alternatives 4 and 5) were rejected because monitoring is difficult and/or they would result in less accurate assessments of fishing mortality. The development of more selective fishing gear and methods (Alternative 6) is an important goal but regulation is currently not the best way of ensuring implementation since there is insufficient knowledge to determine how incidental catch could be reduced without an unreasonable reduction in the landings of target species.

Even though the No Action alternative probably would not immediately result in a decline in stock abundance, it is not a prudent course at this point for two reasons. First, as discussed in relation to the Preferred Alternative, the best scientific information currently available does not suggest a long-term downward trend in blue shark stock abundance. However, the number of sharks retained in the longline fishery has steadily increased since 1991. (This increase is not uniform across the fishery. The percentage of sharks finned on swordfish and mixed trips has remained fairly constant while it has increased on tuna trips.) As Asian economies recover an increase in demand is almost assured, and with it an increase in the price for fins. Rates of finning would be expected to increase to the degree that captains and owners do not see it as interfering with the capturing and handling of target species. Fishing mortality might eventually approach unsustainable levels. With the current level of uncertainty about total take

(taking into account foreign vessels) there is the danger that fishing mortality could reach unsustainable levels before management agencies were fully aware of the situation. This is especially true for less frequently caught species, for which there is correspondingly less knowledge about stock status. In addition, the practice of finning has become a controversial public issue. No Action on the part of the Council would be unresponsive to several public concerns.

9.2 Alternatives considered to minimize waste and harm to the extent practicable within economic constraints

9.2.1 Alternative 1 (Preferred). No action

9.2.2 Other alternatives considered

Alternative 2. Prohibit the sale, trade or barter of shark fins.

This alternative is essentially equivalent to the first rejected alternative presented to address Objective 2 (see above). In addition, it may assuage some concerns related to the existence value of sharks. But it is rejected for the same reasons as the prohibition alternative above.

Alternative 3. Prohibit the commercial landing or transhippment of shark fins by the Hawaii-based longline fleet without the carcass or a specified percentage of the carcass of each shark.

Two options were considered under this alternative. First, the removal of fins from the carcass could be prohibited. Under this option harvesters would be allowed to gut and bleed the carcass but not allowed to remove the tail or fillet the carcass.[16] The most immediate consequence of adopting this option would be to curtail finning almost completely since there is limited space for storing carcasses, and blue sharks--the major shark species caught in the longline fishery--are currently unmarketable. If carcasses were landed, they have to be disposed of ashore, potentially creating terrestrial environmental impacts. The incentive to land marketable mako and thresher sharks would remain, so the retention of these species might be expected to increase. However, it is unclear how much shark meat the Hawaii market can absorb. Increased landings might drive down prices if demand is limited, perhaps making the sale of meat uneconomic. Because of vessel capacity constraints, some level of high grading would likely occur (where lower value species in the hold are disposed of to make room for high value species just caught), resulting in some level of waste. If this option were also applied to longline vessels acting as receiving vessels for fins from foreign ULT longliners, it would be expected to curtail transshipment of fins as well. Prohibiting filleting aboard is necessary in order to accurately match fins and carcasses. But it would hinder any future efforts to develop markets for blue shark meat since it prevents efficient processing and storage.

16McCoy and Ishihara (p. 107) note that in California, where similar regulations are applied, the tails and fins from thresher sharks can be removed as long as they can be matched to a corresponding carcass. This allows more efficient bleeding of thresher, a major market species, and easier storage since the caudal fin is large.

A second option allows the removal of fins at sea, but the number of carcasses (or specified portion thereof) must correspond to the number of fins (or sets of fins from a single shark) landed. A variation of this, used in the management of the mainland directed shark fishery, is to require that the total weight of fins not exceed some proportion (e.g., 5%) of the total weight of carcasses. This approach presents some additional difficulties in monitoring since separate fins and carcasses have to be accounted for. Overall, it is assumed that the effect would be essentially the same as the first carcass retention option because of the difficulty in marketing blue shark meat. On the other hand, it leaves open the potential for the future development of such a market since sharks could be properly processed and stored at sea.

Alternative 4. Require a minimum product recovery rate.

Under this alternative a minimum product recovery rate would be set based on the amount of the shark that is potentially usable. For example, recoverable meat represents about 25% of blue sharks by weight and 42% of mako and thresher sharks. A minimum rate might thus be set at 30%. The outcome of adopting this alternative is expected to be substantially the same as the carcass retention alternative just discussed. This is problematic if product recovery rates are considered to refer to the amount of an animal that is in fact utilized. It would be impossible to meaningfully mandate that a certain portion of the whole animal be sold or consumed. An added problem with this alternative is that it would be very difficult to administer. Only a portion of each shark would be landed and it would be difficult to determine what proportion of the round weight this actually represented. It might be possible to develop morphometric correlations based on the part of the shark retained or to use an average round weight. However, recovery weights vary depending on animal size, species and physical condition so it seems unlikely that any measure would be very accurate. This would make compliance on the part of fishers difficult.

9.2.3 Reasons for choosing the Preferred Alternative and rejecting the other alternatives

None of the management measures outlined above is likely to lead to higher product recovery rates because of current demand and technical factors. Any action to reduce physical waste, by requiring that a high proportion of the shark carcass is landed, would likely result in another set of unintended environmental problems when unmarketable shark meat was disposed of on land. Carcasses may be better utilized in the ocean environment by scavengers and decomposers. This is why the Council believes that the preferred, no-action alternative is prudent. It must be emphasized that although finning is physically wasteful it is not economically wasteful since almost three-quarters of the value of blue shark, the major species caught in the longline fishery, is contained in the fin. (Most of the remaining value comes from the liver. Meat only accounts for 3% of the value of the whole fish.) If this distinction between physical and economic waste is recognized, than the Preferred Alternative is consistent with Pelagic FMP objective 6: minimizing waste of MUS in fishing operations. The meat from other shark species, with a higher market value, often is retained, as reflected in the small numbers of landed carcasses. In order to reduce physical waste the value of blue shark meat would have increase

substantially. In fact, currently there is no market for blue shark meat. In addition, in order to process and store blue shark meat, longline vessels would have to be re-configured. This is impractical both because it would add substantially to costs and because vessels are configured to handle target species; sharks are an incidental catch with relatively low value. For these reasons measures designed to increase product recovery rates are unlikely to achieve this goal. The Council favors a non-regulatory approach that addresses the demand side by working with processors in the private sector to develop markets for the meat. In addition, the Council encourages the development of new processes and technologies that would allow longline fishers to economically land blue shark meat. These non-regulatory efforts are consistent with objective 7 of the Pelagic FMP, which encourages marketing promotion of management unit species.

Alternative 2 addresses concerns about the existence value of sharks since it would prohibit utilization, which leads to the killing of sharks. The social value attached to knowing that no sharks are being killed must be balanced against market returns from shark utilization and the potential costs that would result from measures designed to prohibit harm and mortality. Further, some aspects of existence value are not extinguished as long as stock abundance remains high. The exceptions to this relate to concerns about inhumane practices. However, available evidence does not support the assertion that inhumane practices are widespread in relation to shark finning. Observer data reveals that only 2% of sharks were finned alive during the first six months of 1998. Part of the problem is due to the fact that sharks have a primitive neurological system and autonomic activity may continue after the animal has been killed. Boated sharks also present a hazard to crew so there may be some reluctance to ensure that there are no signs of life prior to disposing of the carcass overboard. Although inhumane treatment is reprehensible, in this case it is not something that can be easily addressed through regulation because monitoring compliance would only be feasible on observer-accompanied vessels. Education and public pressure is a more effective way to get crew members to handle sharks expeditiously. Finally, there is insufficient evidence in relation to contemporary cultural practices among Pacific Islanders to support a ban on shark utilization for this reason alone.

9.3 Alternatives considered to regulate bottom longlining and prevent adverse impacts on protected species

9.3.1 Alternative 1 (Preferred). Develop a new definition specifically for bottom longline gear and prohibit its use in the longline prohibited areas in the NWHI and MHI

Bottom longline gear can be better managed if the following definition, specific to this technique, is adopted:

> Bottom longline gear means a type of fishing gear consisting of a main line that exceeds 1 nautical mile in length, lays on the bottom or is suspended no more than 1 fathom from any sea bottom 100 fathoms or less in depth for the majority of its length, is anchored to the bottom, and from which branch or dropper lines with hooks are attached.

This type of gear will be prohibited in the longline prohibited areas in the NWHI (50CFR660.26(b)) and the MHI (50CFR660.26(c)).

9.3.2 Other alternatives considered

Alternative 2. Amend the existing definition for longline gear so that it includes bottom longline gear and then prohibit the use of this method in the protected species zone in the NWHI.

Under this alternative the existing definition for longline gear would be amended so that it includes the type of gear described in Section 7.2.3.2. For example, reference to the gear being "suspended in the water column" could be removed from the existing definition so that it simply referred to a 'horizontally deployed' mainline. Once the amended definition encompassed bottom longline gear, this method would be--by definition--prohibited in all existing longline prohibited areas in Hawaiian waters and Guam (50CFR660.26).

Alternative 3. No action.

9.3.3 Reasons for choosing the Preferred Alternative and rejecting the other alternatives

Simply amending the existing definition of pelagic longline gear so that it encompasses bottom longlining would be a simple approach. The disadvantage is that not all of the US-flag entities in the Council region wish to prohibit bottom longlining. Representatives in Guam and CNMI have expressed an interest in developing a directed shark fishery, in part as a control method. Because of the longline prohibited area around Guam, developing such a fishery using bottom longline gear would not be possible. It is therefor better to create a new regulatory definition specific to bottom longlining. Then the method can be specifically banned in Hawaiian waters.

9.4 Alternatives considered to manage sharks under appropriate fishery management plans for each species or species group

9.4.1 Alternative 1 (Preferred). No action

9.4.2 Other alternatives considered

Alternative 2. Redefine pelagic MUS to include only those shark species known to be exclusively pelagic and treat other shark species thus excluded as bycatch or redefine them as MUS under other, more appropriate fishery management plans.

Only those sharks encountered in the EEZ of the Council region and are considered exclusively pelagic would be defined as PMUS. (See Table 7 for a listing of those species. The table also indicates which species would be included under the other alternatives considered here.) Note however, that some of these pelagic species are infrequently (or never) caught and some are frequently caught but never sold or utilized. In addition, other species which do not primarily occupy the pelagic habitat are sometimes (but not frequently) caught. Other shark species that are currently PMUS by virtue of being members of one of the four defined families could be redefined as MUS under other plans such as the Coral Reef Ecosystem or Bottomfish

and Seamount Groundfish plans. Or they could simply be treated as bycatch, like other infrequently caught species (e.g., lancetfish, molas).

Alternative 3. Include only those shark species known to be frequently caught in the Hawaii-based longline fishery as pelagic MUS. (And redefine any other important species under other plans or continue to treat them as bycatch, as above.)

The best source of information on the species composition of sharks caught by the pelagic fisheries is the NMFS observer data. Looking just at the number of shark that are not blue shark, only oceanic whitetip shark, silky shark, the three thresher shark species, shortfin mako shark, and crocodile shark comprise more than 1% of the remaining shark catch. This option would not include as pelagic MUS the other, more infrequently caught species. The infrequently caught species would be identified on a list of "other sharks" for reporting and monitoring purposes.

Table7: Shark Management Unit Species under different alternatives.						
Species	**Family**	**Alt. 1**	**Alt. 2**	**Alt. 3**	**Alt.4**	**Alt.5**
Pelagic Sharks						
Pelagic thresher shark (*Alopias pelagicus*)	Alopiidae	Yes	Yes	Yes	Yes	Yes
Bigeye thresher shark (*Alopias superciliosus*)	Alopiidae	Yes	Yes	Yes	Yes	Yes
Common thresher shark (*Alopias vulpinus*)	Alopiidae	Yes	Yes	Yes	Yes	Yes
Silky shark (*Carcharhinus falciformis*)	Carcharhinidae	Yes	Yes	Yes	?	Yes
Oceanic whitetip shark (*Carcharhinus longimanus*)	Carcharhinidae	Yes	Yes	Yes	?	Yes
Blue shark (*Prionace glauca*)	Carcharhinidae	Yes	Yes	Yes	?	Yes
Basking shark (*Cetorhinus maximus*)	Cetorhinidae	No	Yes	No	No	No
Shortfin mako shark (*Isurus oxyrinchus*)	Lamnidae	Yes	Yes	Yes	Yes	Yes
Longfin mako shark (*Isurus paucus*)	Lamnidae	Yes	Yes	No	Yes	Yes
Great white shark (*Cacharodon carcharias*)	Lamnidae	Yes	Yes	No	No	No
Salmon shark (*Lamna ditropis*)	Lamnidae	Yes	Yes	No	?	Yes
Megamouth shark (*Megachasma pelagios*)	Megachasmidae	No	Yes	No	No	No
Crocodile shark (*Pseudocarcharias kamoharai*)	Pseudocarchariidae	No	Yes	No	No	No
Whale shark - (*Rhincodon typus*)	Rhincodontidae	No	Yes	No	No	No
Pygmy shark (*Euprotomicrus bispinatus*)	Squalidae	No	Yes	No	No	No
Cookiecutter shark (*Isistius brasiliensis*)	Squalidae	No	Yes	No	No	No
Velvet dogfish (*Scymnodon squamulosus*)	Squalidae	No	Yes	No	No	No
Coastal Sharks						
Silvertip shark (*Carcharhinus albimarginatus*)	Carcharhinidae	Yes	No	No	No	No
Grey reef shark (*Carcharhinus amblyrhynchos*)	Carcharhinidae	Yes	No	No	No	No
Galapagos shark (*Carcharhinus galapagensis*)	Carcharhinidae	Yes	No	No	No	No
Bull shark (*Carcharhinus leucas*)	Carcharhinidae	Yes	No	No	No	No
Blacktip shark (*Carcharhinus limbatus*)	Carcharhinidae	Yes	No	No	No	No
Blacktip reef shark (*Carcharhinus melanopterus*)	Carcharhinidae	Yes	No	No	No	No
Dusky shark (*Carcharhinus obscurus*)	Carcharhinidae	Yes	No	No	No	No
Sandbar shark (*Carcharhinus plumbeus*)	Carcharhinidae	Yes	No	No	No	No
Tiger shark (*Galeocerdo cuvier*)	Carcharhinidae	Yes	No	No	No	No
Sicklefin lemon shark (*Negaprion acutidens*)	Carcharhinidae	Yes	No	No	No	No
Whitetip reef shark - (*Triaenodon obesus*)	Carcharhinidae	Yes	No	No	No	No
Tawny nurse shark (*Nebrius ferrugineus*)	Ginglymostomatidae	No	No	No	No	No
Scalloped hammerhead shark (*Sphyrna lewini*)	Sphyrnidae	Yes	No	No	No	No
Smooth hammerhead shark (*Sphyrna zygaena*)	Sphyrnidae	Yes	No	No	No	No
Zebra shark (*Stegostoma fasciatum*)	Stegostomatidae	No	No	No	No	No

Table 7 (Cont.)

Species	Family	Alt. 1	Alt. 2	Alt. 3	Alt.4	Alt.5
Deep-Benthic Sharks						
Bignose shark (*Carcharhinus altimus*)	Carcharhinidae	Yes	No	No	No	No
Gulper shark (*Centrophorus granulosus*)	Centrophoridae	No	No	No	No	No
Mosaic gulper shark (*Centrophorus tessellatus*)	Centrophoridae	No	No	No	No	No
Prickly shark (*Echinorhinus cookei*)	Echinorhinidae	No	No	No	No	No
Sixgill shark (*Hexanchus giseus*)	Hexanchidae	No	No	No	No	No
Sand tiger shark (*Odontaspis ferox*)	Odontaspididae	No	No	No	No	No
Bigeye sand tiger shark (*Odontaspis noronhai*)	Odontaspididae	No	No	No	No	No
False cat shark (*Psuedotriakis microdon*)	Pseudotriakidae	No	No	No	No	No
Combtooth dogfish (*Centroscyllium nigrum*)	Squalidae	No	No	No	No	No
Kitefin shark (*Dalatias licha*)	Squalidae	No	No	No	No	No
[No common name] (*Etmopterus bigelowi*)	Squalidae	No	No	No	No	No
Blackbelly lantern shark (*Etmopterus lucifer*)	Squalidae	No	No	No	No	No
Smooth lantern shark (*Etmopterus pusillus*)	Squalidae	No	No	No	No	No
Hawaiian lantern shark (*Etmopterus villosus*)	Squalidae	No	No	No	No	No
Triangle-jaw lantern shark (*Trigonognathus kabeyai*)	Squalidae	No	No	No	No	No
Roughskin dogfish (*Squalus asper*)	Squalidae	No	No	No	No	No
Greeneye spurdog (*Squalus mitsukurii*)	Squalidae	No	No	No	No	No

Yes-species is included as pelagic MUS under alternative; No-species is not included as pelagic MUS under alternative; ?- Inclusion of species dependent on utilization.
Alternative 1- No Action
Alternative 2- Redefine pelagic MUS to include only those shark species known to be exclusively pelagic and treat other shark species thus excluded as bycatch or redefine them as MUS under other, more appropriate fishery management plans.
Alternative 3- Include only those shark species known to be frequently caught in the Hawaii-based longline fishery as pelagic MUS. (And redefine any other important species under other plans or continue to treat them as bycatch, as above.)
Alternative 4- Exclude shark species as pelagic MUS if they are not utilized. (As above, these species would be treated as bycatch, and selected species could be included under other plans, if appropriate.)
Alternative 5- Include those shark species identified in Alternative 3 and longfin mako shark and salmon shark as pelagic MUS. (As above, treat other species as bycatch or redefine under other FMPs.)

Alternative 4. Exclude shark species as pelagic MUS if they are not utilized. (As above, these species would be treated as bycatch, and selected species could be included under other plans, if appropriate.)

Crocodile shark is frequently caught but has no use or commercial value at this time. If in the future shark finning is more restricted (through quota restrictions for example) or banned entirely, many other pelagic shark species may have no remaining commercial value. These species could then be excluded as pelagic MUS but continue to be included on a list of "other" sharks for reporting, monitoring, and bycatch regulation purposes. Depending on the future regulatory environment, this alternative might eventually restrict the pelagic MUS to include only those sharks whose carcasses are retained because there is a market for their meat (i.e., thresher and mako sharks).

Alternative 5. Include those shark species identified in Alternative 3 and longfin mako shark and salmon shark as pelagic MUS. (As above, treat other species as bycatch or redefine under other FMPs.)

Alternative 3 excludes longfin mako and salmon sharks as pelagic MUS because they are caught infrequently. However, mako is one of the few sharks caught in the Hawaii-based longline fishery whose flesh has commercial value and is thus frequently retained. And although salmon shark (*Lamna ditropis*) does not occur in the EEZ, it is frequently captured by the Hawaii-based longline fishery in the North Pacific Transition Zone. This shark's flesh is potentially marketable and for this reason would be retained as a pelagic MUS. This alternative simply adds these two species to those enumerated under Alternative 3.

9.4.3 Reasons for choosing the Preferred Alternative and rejecting the other alternatives

Table 7 lists shark species encountered in the Council region by preferred habitat and whether they would be included as PMUS under the alternatives considered here. As noted, species that are members of Alopiidae, Lamnidae, Sphyrnidae or Carcharhinidae and are currently defined as pelagic MUS. It should be noted that unidentified sharks forms a large category in observer reports; it is thus possible that additional species are caught in the fishery, although probably rarely. It was decided that no action should be taken on this issue until other FMPs can be amended to include any inshore shark species that might be excluded from the Pelagic FMP through MUS redefinition. It is also expected that several inshore species would be most appropriately included in the Coral Reef Ecosystem FMP, which is currently in preparation. Once this plan is completed, a separate action will be undertaken to appropriately apportion shark species among the various Council FMPs.

10 Impacts of the Proposed Actions and Alternatives

The National Environmental Policy Act requires federal agencies to consider the environmental impacts of the alternatives including the proposed action on the human environment. Social and economic impacts should be considered as they relate to impacts on the physical environment. This section is intended to address the requirement to comprehensively

and concisely consider the impacts of the proposed actions. For each set of management alternatives discussed in Section 9, the biological, economic and social impacts are briefly considered.

10.1 Impacts of the alternatives considered to ensure that exploitation in Council-managed fisheries is sustainable

10.1.1 Biological/Ecological

Alternatives 2 and 3, which respectively prohibit landing shark products in all Council-managed fisheries or in the Hawaii-based longline fishery, would result in lower levels of mortality to sharks. Mortality would only result from the gear itself, not subsequent exploitation. In the longline fishery this represents about 14% of sharks caught. The other Council-managed fisheries are also hook and line, including troll. Gear-related mortality is similar, or, in the case of troll, lower. Purse seining results in 100% mortality so any prohibition would have no effect on mortality. In any case, the Council does not have direct authority over this fishery. Assuming that all sharks brought to the gunwale dead are utilized, the Preferred Alternative would result in a total mortality rate of about 50%, based on the number of sharks caught in 1998 (i.e., slightly more than 50,000 out of 99,919). It also provides a safeguard for less abundant shark species, which may be more vulnerable to overfishing, through the trip limit for non-blue sharks. Alternative 4, basing an annual quota on weight rather than numbers, would be designed to result in a level of mortality equivalent to the Preferred Alternative. Alternative 5 contains two variations, prohibiting the taking of female sharks or immature sharks. These variations would reduce overall mortality since fewer sharks would be retained. Observers collect data on sex and length frequencies, but an assessment of the likely take based on this alternative is dependent on analysis in the comprehensive stock assessment project (see Section 7.1.2) and is not yet available. Blue sharks are known to segregate geographically by sex and size, making analysis difficult since observer effort does not match fleet effort. Generally, sex or sized-based prohibitions would allow a higher sustainable take since mortality on the reproductive component of the population wold be lower. As noted above, Alternative 6 (changes in gear to reduce bycatch and bycatch mortality) is not incompatible with the other alternatives considered. Unfortunately, at this time there is limited information to require changes in gear or fishing strategy that would significantly reduce shark catches without unduly affecting the catch rate for target species. If only limited changes were required, such as prohibiting wire leaders, shark catch rates would decrease. But if no other controls were implemented, there would be little change in actual landings and the observed increasing trend would continue (depending on demand factors), perhaps eventually reaching unsustainable levels.

Although the Preferred Alternative allows greater shark mortality than Alternatives 2 or 3, the best available data do not indicate that the current level of shark mortality is unsustainable. Alternative 5 would reduce mortality, but not to the extent of Alternatives 2 and 3. It would allow higher sustainable takes but is more difficult to implement. The Preferred Alternative, a harvest guideline for the Hawaii longline fishery, therefor represents a balanced approach intended to ensure sustained use of sharks. The initial quota is set at a level that reflects landings over the period 1996-1998. It thus represents a stabilization, or decrease, compared to the recent

landings. The direct impact of changes in landings relate to changes in population structure (age, size frequency, sex ratio, etc.) and the ecological effect of removing that number of predators and/or prey. (Since sharks are for the most part top-level predators they may not represent lost prey.) These impacts can be very difficult to quantify. However, as noted above, recent ecological modeling indicates that sharks are not keystone predators in the central Pacific. Most retained sharks are finned and the carcass is disposed of at sea. This increases biological loading (due to decomposition) and provides a food source for scavengers. Given that fishing operations are dispersed on the high seas the disposal of carcasses is unlikely to have a significant impact.

10.1.2 Economic and social

Since all alternatives except for Alternative 6, would result in a reduction in landings, they would be expected to have an economic impact by reducing fishermen's incomes. These impacts are outlined in the Regulatory Impact Review found in Appendix A. In all cases the most direct impact would be to reduce fishers' incomes. It is estimated that the Preferred Alternative would result in 16.8% reduction in crew income from finning, or a 1.7% ($437) reduction in overall income per crew member. The rejected alternatives which propose a total ban on landing sharks in all Council-managed fisheries or the Hawaii-based longline fishery (Alternatives 2 and 3) would have the largest impact on fishers' incomes. The Hawaii-based fleet realized $1,045,000 from fins and $42,000 from meat in 1998 so a comparable reduction in total revenue would be expected under a ban. In addition, revenues derived from transshipment activities would also be lost. Alternative 4 would have the same economic impact as the Preferred Alternative. The economic impact of Alternative 5, using size- or sex-based restrictions, is difficult to assess since the probable landings under this alternative cannot be estimated. The analysis in Appendix A, which assumes a sex-based restriction and that 50% of sharks caught are female, suggests that the impact on crew income resulting from landings restrictions would be greater than the preferred alternative. In summary, the primary impact of all of the alternatives, in comparison to no action, would be reduce crew incomes moderately to slightly. In addition, any total ban would cut off revenue in Hawaii derived from transshipment activities. All of these economic impacts would only have an environmental impact if it caused a change in behavior or fishing strategy that resulted in some effect. For example, if it resulted in increased exploitation of another species or stock. However, given that income is shared among crew members, but not owners and skippers, changes in income would not directly affect the people who determine vessel operation and fishing strategy. Thus economic factors are unlikely to have an environmental impact.

Another economic impact under the Preferred Alternative is the added cost of monitoring and enforcement. Agency staff resources would have to be devoted to monitoring and tabulating shark catch in-season in order to determine a closure date. In addition, more enforcement resources would be required dockside to ensure that the number of fins landed corresponded to logbook reports and prevent landings after the closure date. Some costs would also fall on fishers. A slightly higher level of recordkeeping and reporting would be required, and a commensurate amount of time would have to be allocated by vessel owners and/or crew. Fishing

trips would have to be more carefully coordinated with respect to the closure date so that any blue shark fins retained on board the vessel could be landed before the closure date.

10.2 Impacts of the alternatives considered to minimize waste of and harm to sharks

10.2.1 Biological/Ecological

As noted above, achieving a higher rate of utilization is constrained due to several factors. Blue sharks, the major species caught, are difficult to process and preserve and currently there is not local market for the flesh. Alternative 1, a prohibition on finning, would have an impact similar to a landings ban: mortality would result only from the gear itself. Alternatives 3 and 4 require that part or all of the carcass be landed along with the fins. Given the constraints already outlined, such a requirement would in part have the practical effect of a quota, based on vessel capacity constraints. This would reduce overall shark mortality, but there is insufficient information to determine how they would compare to the Preferred Alternative's harvest guideline of 50,000 sharks annually. In addition, the physical waste of blue shark flesh would probably continue and could result in terrestrial environmental impacts if unmarketable carcasses had to be disposed of ashore. As already noted, at-sea disposal may have some ecological benefits to the degree that the 'recycling' of carcasses within the environment has a positive effect. Since fishing operations are widely dispersed on the high seas there is no chance that decomposition of carcasses in the water column would cause undue biological loading. In fact, it is likely that scavengers would consume most of the carcass before it reached abyssal depths. The Preferred Alternative, no action, when combined with the annual harvest guideline, will not result in serious environmental impacts.

10.2.2 Economic and Social

The direct economic effect of the rejected alternatives which ban finning would be to reduce fishers' incomes to a degree equivalent to the landings bans outlined previously. As already argued, because of various constraints, a finning ban would effectively result in blue sharks not being retained by Hawaii-based longline vessels. (For an extended discussion of the economic impacts refer to Appendix A.)

As discussed in Section 8.3, there are a variety of concerns grouped together as related to the existence value of sharks. These concerns may be seen as facets of the public's perceptions about the natural environment and thus need to considered in assessing environmental impacts. Some members of the public are concerned that sharks suffer when finned because they may survive in a mortally wounded state for some considerable period of time afterwards. However, observer reports indicate that 98% of the sharks brought aboard fishing vessels alive are killed before they are finned. (Out of all sharks caught, about 86% are alive when brought to the gunwale. Obviously, the 98% figure does not apply to the remaining 14% that are already dead when brought aboard.) Thus the allegation--frequently encountered in press reports--that sharks many suffer because they live for a long time after being finned does not appear to be supported by fact. It is also true that the preferred alternatives may not satisfy those native Hawaiians who express a spiritual connection with sharks that is compromised by their commercial exploitation. But there are other segments of society, both religious and cultural, that may consider the killing

and/or finning of sharks counter to their values. These concerns have been considered collectively and also balanced against the interests of both fishers and consumers of shark products. As with any absolute position, it is difficult, if not impossible, to satisfy those who want no shark killed when seeking to balance interests in a diverse public.

10.3 Impacts of the alternatives considered to regulate bottom longlining and prevent adverse impacts on protected species

10.3.1 Biological

The prohibition on bottom longlining in the main and Northwest Hawaiian Islands is primarily intended to prevent potential gear interactions with the endangered monk seal. There is concern that seals could hook on or become entangled in the gear and drown. Since their population is at a very low level, it is essential to minimize potential human sources of mortality. However, the hard parts from both green and loggerhead turtles (*Chelonia mydas* and *Caretta caretta*) were found in the stomachs of landed sharks (see footnote 10). The removal of sharks by fishing may thus reduce predation on these threatened species, aiding more rapid recovery of their populations. There is also concern that unregulated fishing on coastal shark populations could lead to population declines and ecological effects. Smith, et al., (1998) determined that slow-growing, late-maturing inshore sharks are the least resilient to fishing mortality. The main target species, sandbar sharks, have a relatively low r_{2M}. Galapagos and tiger sharks, also commonly caught, have moderate r_{2M} values. A review of data from shark control programs in Hawaii (Wetherbee et al. 1994) indicates that coastal shark populations can be rapidly fished down but may recover in 2-7 years. The authors also point out the important role that coastal sharks play as apex predators in inshore ecosystems; depletion could thus indirectly affect other species's stocks through disturbance of the food web. Therefor, widespread bottom longlining that targeted sharks would have to be very closely monitored and managed to be sustainable. For these reasons the prohibition on bottom longlining will have largely positive environmental impacts in comparison to Alternative 3, no action. Alternative 2, which would amend the existing definition of longline gear, would prevent bottom longlining in other exclusion zones--currently around Guam and potentially around American Samoa islands for vessels over 50 l.o.a. if a pending regulatory amendment is adopted. Since there is currently no such fishery in these areas, the environmental impacts of this alternative do not differ from the Preferred Alternative. If such a fishery develops, as is possible under the Preferred Alternative, impacts obviously would result. Problems with endangered species are less likely since the monk seal does not occur outside of Hawaiian waters in the Council region. The issue of unsustainable exploitation of target species (i.e., coastal sharks) would present itself but could be addressed with regulations pertinent to the specific situation.

10.3.2 Economic and social

The prohibition on bottom longlining will have no immediate impact since the single vessel engaged in this activity has ceased operations. However, it will prevent the revival of this fishery and any future revenues that might be derived from this activity. But no interest has so far been expressed by others in reviving this fishery.

10.4 Impacts of the alternatives considered to manage sharks under appropriate fishery management plans for each species or species group

No direct environmental, economic or social impacts are expected from either the preferred or rejected alternatives. The current situation, where oceanic sharks are defined non-specifically, is adequate for management but could be improved to make monitoring easier and more efficient. As noted, a reorganization of shark MUS will be addressed in a future, separate management action. Future action (based on one of the rejected alternatives) will have a beneficial effect to the degree that it allows more effective management of both oceanic and coastal sharks.

11 Consistency with National Standards for Fishery Conservation and Management

National Standard 1 states that conservation and management measures shall prevent overfishing while achieving, on a continuing basis, the optimum yield from each fishery for the United States fishing industry. The implementation of a harvest guideline for shark landings by the Hawaii-based longline fishery (the Preferred Alternative) is intended to prevent overfishing while recognizing the economic benefits derived from utilization of sharks. As discussed in Sections 7.1.2 and 8.2, the best available evidence does not indicate that current exploitation of blue shark stocks is unsustainable and Hawaii-based fishers derive valued income from their exploitation. However, given current uncertainties about blue shark stock status, implementation of a harvest guideline is considered prudent. Other species represent a much smaller part of the catch but given lower abundance they may be more threatened with over-exploitation. In addition, a market exists for the meat from these species. The limit of one non-blue shark per boat per boat is intended to prevent overfishing while allowing the meat from these species to be marketed. As discussed in Sections 7.2.3.2 and 8.4, the proposed prohibition of bottom longlining recognizes that a special situation exists in relation to potential impacts on endangered species such that a precautionary approach requires prohibiting this gear type until further information on its potential for interactions with protected species is available.

National Standard 2 states that conservation and management measures shall be based upon the best scientific information available. The proposed harvest guideline for sharks landed by the Hawaii-based longline fishery is based on fishery-derived indicators of stock abundance. In addition, as noted in Section 7.1.2, the NMFS Honolulu is currently carrying out an assessment of blue shark stocks in order to improve the information base for management. The prohibition of bottom longlining in Hawaiian waters is based on current knowledge about the vulnerability of the main target species (sandbar shark) to over-exploitation. Knowledge about the impacts of the fishery are derived from an observer report (see footnote 10).

National Standard 3 states that, to the extent practicable, an individual stock of fish shall be managed as a unit throughout its range, and interrelated stocks of fish shall be managed as a unit or in close coordination. The annual harvest guideline for shark landings by the Hawaii-based longline fishery is based on fishery-derived indicators of stock abundance and recognizes foreign fishing on the same stocks as domestic vessels. The coastal shark species affected by the prohibition on bottom longlining (see Section 9.3) have a range largely confined to Hawaiian

waters and inshore areas. The management action therefor affects these stocks as a unit. The actions discussed in Section 9.4, to be implemented at a later date, are aimed at managing shark species or species groups under the most appropriate fishery management plans. This will allow more effective management of individual species as a stock throughout their range.

National Standard 4 states that conservation and management measures shall not discriminate between residents of different States. If it becomes necessary to allocate or assign fishing privileges among various United States fishermen, such allocation shall be (A) fair and equitable to all such fishermen; (B) reasonably calculated to promote conservation; and (C) carried out in such manner that no particular individual, corporation, or other entity acquires an excessive share of such privileges. The preferred management measures are not expected to discriminate between residents of different States or allocate fishing privileges among US fishermen.

National Standard 5 states that conservation and management measures shall, where practicable, consider efficiency in the utilization of fishery resources; except that no such measure shall have economic allocation as its sole purpose. Maximum efficient utilization of fishery resources was considered in formulating the annual quota and framework adjustment process. Although the prohibition on bottom longlining will eliminate the utilization of available coastal shark resources, it is seen as necessary as this time to protect endangered species in the NWHI and vulnerable coastal shark species throughout Hawaiian waters.

National Standard 6 states that conservation and management measures shall take into account and allow for variations among, and contingencies in, fisheries, fishery resources and catches. The Preferred Alternatives address this issue via their spatial restriction to Hawaii fisheries, as that is where concerns over shark harvests have arisen.

National Standard 7 states that conservation and management measures shall, where practicable, minimize costs and avoid unnecessary duplication. The preferred alternatives do not duplicate existing laws, regulations or requirements. These alternative do impose some costs, both in terms of lost fishing revenue and costs associated with additional reporting, but these costs are more than balanced by their contribution to resource sustainability..

National Standard 8 states that conservation and management measures shall be consistent with the conservation requirements of the Magnuson-Stevens Act (including the prevention of overfishing and rebuilding of overfished stocks), take into account the importance of fishery resources to fishing communities in order to (A) provide for the sustained participation of such communities, and (B) to the extent practicable, minimize adverse economic impacts on such communities. The preferred alternatives balance concerns for overexploitation and waste with the economic importance of shark harvesting and finning to fishermen from Hawaii, American Samoa, Guam and CNMI.

National Standard 9 states that conservation and management measures shall, to the extent practicable, (A) minimize bycatch and (B) to the extent bycatch cannot be avoided, minimize the mortality of such bycatch. Although currently viewed as incidental (non-target) catch, limitations on the number of sharks which can be landed could lead to an increase in bycatch (discards) if the annual quota is less than the number of sharks caught. However, the proposed quota (50,000 blue sharks annually and one shark carcass of other species per vessel trip) is far greater than the number of sharks annually brought to the boat dead. Thus any discards (bycatch) are likely to be live sharks which are thought to have a fairly good chance at survival. The only feasible alternative to reducing this bycatch is to allow unlimited finning with its associated low product recovery rate.

National Standard 10 states that conservation and management measures shall, to the extent practicable, promote the safety of human life at sea. Fishermen can be injured when handling sharks because of their powerful bite. To the degree that the preferred management measures reduce shark catches, there may be a concomitant reduction in such injuries. In the Hawaii-based longline fishery, once the harvest guideline is met, it is expected that sharks will be cut loose instead of being boated since regulations would prevent their retention. Recently implemented regulations require Hawaii-based longline vessels to carry line clippers in order to release incidentally captured sea turtles. These line clippers could also be used to safely cut free sharks. The prohibition on bottom longlining would have a similar effect on safety since fishermen would no longer come in contact with sharks in the context of this fishery.

12 Relationship to Other Applicable Laws and Provisions of the Magnuson-Stevens Act

12.1 National Environmental Policy Act

This FMP amendment has been written and organized in a manner that meets NEPA requirements, and is intended to serve as an environmental assessment (EA). The Council has determined that the proposed actions will not have a significant adverse impact on the human environment, so an environmental impact statement has not been prepared. Although regulations do not specify the format of an EA, it is common practice to follow the same format as used in an EIS. According to regulations (40CFR1502), this format must incorporate the elements listed below. The corresponding sections in this document are listed opposite each element.

Required Element		Corresponding Section
1.	Cover sheet	1
2.	Summary	2
3.	Table of contents	3
4.	Purpose and need for action	6
5.	Alternatives including proposed action	9
6.	Affected environment	7
7.	Environmental consequences of the preferred action and rejected alternatives	10
8.	List of preparers	4.3
9.	List of agencies, organizations and persons	

to whom copies of the statement are sent 4.2

In addition, a comprehensive EA and EIS, being prepared for the whole Fishery Management Plan for Pelagic Species as result of a recent civil action in the US District Court of Hawaii (CMC vs Daley), reviews the management actions in this amendment. The complaint, stemming concerns about the incidental catch of sea turtles, alleged that the NMFS had failed to properly adhere to NEPA in its decision-making. The Court ordered that a comprehensive analysis is needed to evaluate the impact of pelagic fisheries under Council management on protected species and the effects of existing and proposed management measures on those species and the fishery. The actions outlined in this amendment to manage shark catches are being considered as one part of the alternatives considered in the context of the Court ordered EA and EIS.

12.1.1 Conclusions and determination

1. The proposed action will not jeopardize the sustainability of any target species that may be affected by the action;
2. The proposed action will not jeopardize the sustainability of any non-target species.
3. The proposed action will not cause substantial damage to the ocean and coastal habitats and/or essential fish habitat as defined under the Magnuson-Stevens Act and identified in FMPs.
4. The proposed action will not have a substantial adverse impact on public health or safety.
5. The proposed action will not affect adversely an endangered or threatened species or a marine mammals or critical habitat of these species
6. The proposed action will to result in cumulative adverse effects that could have a substantial effect on the target species or non-target species.
7. The proposed action will not have a substantial impact on biodiversity and ecosystem function within the affected area (e.g., benthic productivity, predator-prey relationships, etc.)
8. The proposed action will not produce significant social or economic impacts that are interrelated with significant natural or physical effects.
9. Although controversy has surrounded the issue of shark finning, no action should be deemed to be significant based solely on its controversial nature. Given no significant impact in relation to the other criteria listed here, controversy does not support preparation of an environmental impact statement.
10. The proposed action will not have any effect on upon flood plains or wetlands, nor upon any trails and rivers listed or eligible for listing on the National Trails and Nationwide Inventory of Rivers.

Based on the information contained in this document, I have determined that the proposed alternatives to limit the harvest of sharks by the Hawaii-based longline fishery and to

prohibit the bottom longline fishery in existing longline closed areas in the NWHI and MHI will not significantly affect the quality of the human environment, and therefore, preparation of an environmental impact statement is not required under the National Environmental Policy Act or its implementing regulations. Therefore, a finding of no significant impact is appropriate.

_____

Date

NOAA Assistant Administrator for Fisheries

12.2 Executive Order 12866

Executive Order 12866 requires that long term national net costs and benefits of significant regulatory actions be assessed through the preparation of Regulatory Impact Reviews (Appendix A). The results are summarized in Section 12.3 below.

12.3 Regulatory Flexibility Act

A complete analysis of the economic impacts of these alternatives is attached as Appendix A (Draft Regulatory Impact Review/Initial Regulatory Flexibility Analysis for Proposed Amendment 9 to the Fishery Management Plan for Pelagic Fisheries of the Western Pacific Region Regarding Sharks). In summary, the direct economic impacts of the above 22 alternatives range from zero (no action) to an estimated annual loss of approximately $1,706,000 (a prohibition on the landing of sharks and shark products in all Council-managed fisheries and a ban on the domestic transhippment of sharks and shark products through the US-flag island Pacific ports of Hawaii, American Samoa, Guam and the Northern Mariana Islands). The cost of this latter alternative would be borne by the owners, captains and crew of fishing vessels, shark fin traders, and domestic transhipping operators. Local and US mainland consumers of sharks and shark products would also be impacted by reduced supplies. Although it is likely that these would be replaced by an increase in readily available imports of these products, such substitution would represent a net national cost. Small declines in tax revenues are also anticipated under this alternative. Due to variations in local conditions, this alternative was rejected as being overly restrictive and economically inefficient.

Under the preferred alternative for this first management issue, an annual harvest guideline of 50,000 blue sharks or sets of blue shark fins will be applied to the Hawaii-based longline fleet and a framework process will be established which will allow for adjustments to this guideline. In addition a trip landing limit of one non-blue shark, which must be landed whole or dressed would be implemented. The majority of the economic impact for this alternative is expected to be borne by the crew members of these vessels as they usually share the shark fin revenues between themselves. However, the harvest guideline allows for some harvesting to continue and it is estimated that the average total annual loss will be $437 per crew member ($185,000 for the fleet as a whole). This represents approximately 1.7% of this group's average annual income. Also impacted by this alternative would be Hawaii shark traders who contributed between $332,000 and $399,000 to Hawaii's economy in 1998. Assuming the same scenario as

above this group would see a 16.8% decline in their annual shark fin revenues. This alternative is preferred because it adopts a conservative approach until further data on shark populations is available, yet still allows for utilization of shark resources and development of new markets for shark products.

Economic impacts of alternatives under management issue 2 (concerns for waste and harm to sharks) range from zero (no action) to $1,655,000 (prohibit the possession, sale, trade or barter of shark fins in all Council-managed fisheries, and by all domestic transhippers in US flag Pacific ports). This latter alternative was rejected due to the under utilization of available resources, especially in light of the proposed limitation on shark harvests via an annual harvest guideline. Other rejected alternatives would have mandated that shark carcasses be landed in association with any fins, or that a certain percentage of each shark be actually utilized (either through sale or home consumption). The first was rejected as being economically inefficient as it would lead to shark carcasses being dumped as garbage in landfills. The second was seen as logistically unenforceable. The preferred alternative for this management issue is no action as a market for blue shark meat has not been located and concerns for blue shark populations are being addressed through the annual harvest guideline.

The one participant in the demersal longline fishery around the NWHI took two trips during 1999, and has since exited the fishery and left Hawaii. Data on his costs and revenue is unavailable, however during the one trip on which a NMFS observer was onboard, the observer reported that 44,380 pounds of dressed shark and 7,430 pounds of shark fillets were offloaded and shipped to Asian markets (see footnote 10). The potential for further landings and associated revenues from demersal longline sharks caught in the Federal waters of the NWHI will be forgone if a ban on this gear is implemented, as proposed in the Preferred Alternative addressing issue 4.

12.4 Coastal Zone Management Act

The CZMA requires a determination that a recommended management measure has no effect on the land or water uses or natural resources of the coast zone, or is consistent to the maximum extent practicable with an affected state's approved coastal zone management program. A copy of this document has been submitted to the appropriate state government agency in Hawaii for review and concurrence with a determination made by the Council that the recommended measure is consistent, to the maximum extent practicable, with the state's coastal zone management program.

12.5 Endangered Species Act

Species listed as endangered or threatened under the Endangered Species Act (ESA) that have been observed in the area where Hawaii-based longline vessels operate are as follows:

Species listed as endangered

Short-tailed albatross (*Phoebastria albatrus*) - except in the States of Hawaii, Oregon, Washington and California

Hawaiian monk seal *(Monachus schauinslandi*)

Pacific olive ridley turtle (*Lepidochelys olivacea*)
Leatherback turtle (*Dermochelys coriacea*)
Hawksbill turtle (*Eretmochelys imbricata*)
Green turtle (*Chelonia mydas*) - Florida and Pacific coast of Mexico breeding populations only

Humpback whale (*Megaptera novaeangliae*)
Sperm whale (*Physeter macrocephalus*)
Blue whale (*Balaenoptera musculus*)
Fin whale (*B. Physalus*)
Sei whale (*B. Borealis*)

Species listed as threatened

Loggerhead turtle (*Caretta caretta*)
Asian stocks of Pacific olive ridley and green turtles

Two recent actions are intended to lessen the impacts of the Hawaii-based longline fishery on threatened and endangered species. In the case mentioned in Section 12.1 (CMC vs Daley) the Court's injunction had several components. As mentioned above, longline vessels must carry line clippers and dip nets so that sea turtles can be easily released from gear. The Court ordered NMFS to impose a temporary closed area north of 28° N and between 168° W and 150° W. NMFS subsequently implemented the area closure on December 23rd 1999. In addition, NMFS was also obliged to conduct an analysis in order to determine the best time/area scheme for the Hawaii-based longline fishery in order to minimize adverse impacts to turtles.

Second, the Council recently completed and submitted to NMFS a framework adjustment to the FMP establishing measures to reduce mortality to the black-footed (*Phoebastria nigripes*) and the Laysan (*Phoebastria immutabilis*) albatrosses due to inadvertant hooking by longliners.

The proposed annual quota for sharks caught in the Hawaii-based longline fishery is not expected to affect the nature or intensity of interactions with endangered or threatened species. (For a description of these interactions see WPRFMC (1998). The prohibition of bottom longlining is expected to prevent potentially fatal interactions between fishing gear and endangered or threatened species. Of particular concern is the monk seal, because of their low numbers. However, the capture of tiger sharks by bottom longlining may be beneficial to both

the monk seal and marine turtles since these sharks are known predators of seals and turtles. Nonetheless, the overall impact is expected to positive.

12.6 Marine Mammal Protection Act

All fisheries in the waters around Hawaii, including the longline fishery, are classified as Category III under Section 118 of the Marine Mammal Protection Act of 1972 (62 FR 28657, May 27, 1997). Interactions are rare and do not pose a management problem. Marine mammals not listed as endangered or threatened under the Endangered Species Act that have been observed in the area where Hawaii-based longline vessels operate are as follows:

Humpback whale (*Megaptera novaeangliae*)
Sperm whale (*Physeter macrocephalus*)
Blue whale (*Balaenoptera musculus*)
Fin whale (*B. Physalus*)
Sei whale (*B. Borealis*)
Pacific white-sided dolphin (*Lagenorhynchus obliquidens*)
Rough-toothed dolphin (*Steno bredanensis*)
Risso's dolphin (*Grampus griseus*)
Bottlenose dolphin (*Tursiops truncatus*)
Pantropical spotted dolphin (*Stenella attenuata*)
Spinner dolphin (*Stenella longirostris*)
Striped dolphin (*Stenella coeruleoalba*)
Melon-headed whale (*Peponocephala electra*)
Pygmy killer whale (*Feresa attenuata*)
False killer whale (*Pseudorca crassidens*)
Killer whale (*Orcinus orca*)
Pilot whale, short-finned (*Globicephala melas*)
Blainville's beaked whale (*Mesoplodon densirostris*)
Cuvier's beached whale (*Ziphius cavirostris*)
Pygmy sperm whale (*Kogia breviceps*)
Dwarf sperm whale (*Kogia simus*)
Bryde's whale (*Balaenoptera edeni*)

The proposed actions outlined in this amendment are not expected to have any adverse impacts on marine mammals.

12.7 Paperwork Reduction Act

The operator of a fishing vessel that participates in the Hawaii-based longline fishery under the FMP is required to maintain and complete daily catch log reports (50 CFR 660.14).

The fisherman must record the date of set, vessel name, permit number, target species, bait used, length of mainline set, number of hooks and floats set, number of light sticks used, wind speed and direction, wave height, sea surface temperature, set begin time and position, end of set time and position, date of haul, begin haul time and position, end of haul time and position, pelagic species caught, number of shark species kept whole (not finned), number of shark species finned, number of shark species not kept and released, number of protected species caught and released (or lost) alive and not injured, number of protected species caught and released injured, number of protected species caught dead, name of vessel captain or vessel operator, and date when the logsheet was completed.

The log form used for the Hawaii longline fishery information collections is approved under OMB No. 0648-0214, Southwest Region Logbook Family of Forms.

This amendment does not impose any new regulatory requirements specific to record keeping. However, under the current regulations (50 CFR 660.14) the Council will request NMFS to obtain additional information from Hawaii-based longline vessels for effective implementation of Amendment 9. In consultation, and with the approval of the Council, and in compliance with the PRA, NMFS will modify the log book form to allow the collection of data for implementation of the amendment. As outlined in section 9.1.1, vessels will have to report at regular intervals the number of shark fins or shark fin sets retained onboard so that managers can accurately determine a closure date after which sharks can no longer be retained. Gathering this information may require the addition of an additional field to the current logbook forms for the tabulation of the number and type of shark fins retained. Fishers may also have to tabulate data more frequently in order to make reports. Therefore, there will be little additional recordkeeping required but an increased reporting burden. It is estimated that the total additional burden hours will be 300 hours per year, assuming 120 vessels in the fleet make an average of 10 trips/year, averaging 15 days/trip and the additional daily burden is 1 minute.

12.8 Essential Fish Habitat

12.9 Amendment 8 to the Pelagic FMP identifies essential fish habitat (EFH) for managed species, as required by the Magnuson-Stevens Act, as re-authorized. Further, management plans (and thus their amendments) must minimize impacts to EFH due to fishing. According to the habitat description for sharks contained in Amendment 8, their EFH "encompass[es] all epipelagic and mesopelagic EEZ waters. This broad designation results from the wide-ranging nature of many species (taken together covering tropical, temperate and even boreal seas) and lack of knowledge about relative density, although for all species taken together densities are higher in neritic and inshore waters." The actions proposed in this Amendment will not adversely affect oceanic shark EFH or, more generally, EFH for pelagic MUS as a whole.

12.10 Traditional Indigenous Fishing Practices

The Magnuson-Stevens Act requires the Council to take into account traditional fishing practices in preparing any FMP or amendment. As outlined in this document, some native Hawaiians have expressed concerns about shark harvests because of traditional spiritual beliefs about sharks. However, it is unclear that these beliefs have precluded particular groups of Hawaiians from harvesting certain species of sharks. In addition, there is insufficient evidence to determine whether the oceanic species harvested in commercial fisheries played a significant role in harvests by indigenous people. Contemporary indigenous fishing will not be affected by the Preferred Alternatives presented here because these proposed measures do not compromise stocks exploited or restrict practices used in indigenous fisheries.

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Appendix A
Regulatory Impact Review/Initial Regulatory Flexibility Analysis
for Proposed Amendment 9 to the Fishery Management Plan
for Pelagic Fisheries of the Western Pacific Region
Regarding Sharks

INTRODUCTION

Executive Order 12866 (E.O. 12866) requires that a Regulatory Impact Review be prepared for all regulatory actions that are of public interest. This review provides an overview of the problem, policy objectives, and anticipated impacts of the action, and ensures that management alternatives are systematically and comprehensively evaluated such that the public welfare can be enhanced in the most efficient and cost effective way. In accordance with E.O. 12866, the following is set forth: (1) This rule is not likely to have an annual effect on the economy of more than $100 million or to adversely affect in a material way the economy, a sector of the economy, productivity, jobs, the environment, public health or safety, or state, local, or tribal governments or communities; (2) This rule is not likely to create any serious inconsistencies or otherwise interfere with any action taken or planned by another agency; (3) This rule is not likely to materially alter the budgetary impact of entitlements, grants, user fees, or loan programs or the rights or obligations of recipients thereof; (4) This rule is not likely to raise novel or policy issues arising out of legal mandates, or the principles set forth in the Executive Order. Based on these findings, this rule is determined not be significant under E.O. 12866.

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.)(RFA) requires that agencies assess and present the impacts of their proposed actions on small business entities. In accordance with the RFA, the following is set forth: (1) The need for, and objective of, the rule are outlined below; (2) Under the preferred alternative, the rule will apply to all permit holders of the 164 permits issued for the Hawaii-based longline fishery, and will also affect the four to five crew members on each vessel who profit from the sale of shark fins, as well as the one or two Hawaii-based shark fin traders who process and sell these fins ; (3) All individuals involved in the Hawaii-based longline shark fin fishery are small business entities; (4) No new reporting requirements are required by this rule; and (5) No Federal rules are known to duplicate, overlap, or conflict with this rule.

PROBLEM STATEMENT AND NEED FOR ACTION

Sharks in the western Pacific region are currently included in the Western Pacific Fishery Management Council's Pelagics Fishery Management Plan (FMP). Recently the management of

Pacific sharks, including the impact of finning, has emerged as a controversial practice. Although Pacific sharks are caught, and finned, in various domestic and foreign fisheries, the Hawaii-based longline fleet stands out among domestic fisheries because of the rapid increase and relatively large absolute number of sharks that are being finned--over 60,000 in 1998. Demand for shark fins is driven by rising incomes in the Far East and an emerging market among Asian-Americans on the US mainland. Pressure to limit or prohibit finning is due to concerns about the sustainability of harvesting large numbers of sharks as many shark species have inherently low productivity rates and are thus vulnerable to depletion. The practice is also regarded as wasteful because in most cases the carcass is discarded after the fins have been removed. Some also view it as inhumane or culturally offensive. Other concerns over the management of sharks include the potential for use of bottom (demersal) longlining in Hawaii waters, and whether it is appropriate to include all species of sharks in the Pelagics FMP.

EXISTING MANAGEMENT MEASURES

The management plan for the pelagic fisheries of the western Pacific region was published in 1987. The FMP includes initial estimates of Maximum Sustainable Yields (MSY) for the stocks and set Optimum Yield (OY) for these fisheries in the EEZ. The Management Unit Species at that time were billfish, wahoo, mahimahi and oceanic sharks. The FMP prohibits drift gillnet fishing within the region's EEZ and foreign longline fishing within certain areas of the EEZ.

Amendment 1 was drafted in response to the Secretary of Commerce Guidelines for the Magnuson Act National Standards requiring a measurable definition of recruitment overfishing for each species or species complex in a FMP. The OY for PMUS was also defined as the amount of fish that can be harvested by domestic and foreign vessels in the EEZ without causing local overfishing or economic overfishing.

Amendment 2 requires domestic longline vessels to have Federal permits, to maintain Federal fishing logbooks and, if planning to fish within 50 nm of the NWHI, to allow observers placed on board. It also includes pelagic fisheries in the EEZ around the Northern Mariana Islands under the FMP

Amendment 3 creates a 50 nm longline exclusion zone around the NWHI to protect endangered Hawaiian monk seals. It also contains framework provisions for establishing a mandatory observer program to collect information on interactions between longline fishing and turtles.

Amendment 4 establishes a three-year moratorium on new entries into the Hawaii-based domestic longline fishery. It also adds a provision for establishing a mandatory vessel monitoring system for domestic longline vessels fishing in the western Pacific region.

Amendment 5 creates a domestic longline vessel exclusion zone around the MHI ranging from 50 to 75 nm and a similar 50 nm exclusion zone around Guam and its offshore banks. The zones are intended to prevent gear conflicts and vessel safety issues arising form interactions between longline vessels and smaller fishing boats. A seasonal reduction in the size of the closure was implemented in October 1992; between October and January, longline fishing is

prohibited within 25 nm of the windward shores of all islands except Oahu, where longline fishing is prohibited within 50 nm from the shore.

Amendment 6 specifies that all tuna species are designated as fish under US management authority. It also applies the longline exclusion zones of 50 nm around the island of Guam and the 50–75 nm zone around the MHI to foreign vessels.

Amendment 7 institutes a limited entry program for the Hawaii-based domestic longline fishery. The number of vessels allowed into the fishery is limited to 167, and the length of these vessels is limited to 101 feet or less.

Amendment 8 contained no regulatory changes but addressed new requirements created by the Sustainable Fisheries Act concerning fishing sectors and communities.

Finally, in December 1999, an emergency rule closed the area above 28° N and between 150° W and 168° W to longline fishing by the Hawaii permitted fleet in order to provide protection to endangered sea turtles.

MANAGEMENT OBJECTIVES

Alternatives have been formulated for each of the following four management objectives:
Objective 1: Ensure that exploitation in Council managed fisheries - and specifically the incidental catch of sharks - is sustainable.
Objective 2: Minimize waste and harm to the extent practicable within economic constraints.
Objective 3: Regulate bottom (demersal) longlining to prevent adverse impacts on endangered species
Objective 4: Manage sharks under appropriate fishery management plans for each species or species group.

MANAGEMENT ALTERNATIVES

The four objectives are addressed below, along with background information, alternative management measures and their estimated economic impacts. The costs and returns of the "no action" alternative were also considered. Because the Hawaii-based longline fleet is the source of the vast majority of Western Pacific domestic shark harvests, and because local objectives vary by area, preferred alternatives to address the first three management objectives focus on Hawaii fisheries only.

Objective 1: Ensure that exploitation in Council managed fisheries - and specifically the incidental catch of sharks - is sustainable

Background: Because of the reproductive biology and population characteristics of sharks, concerns have arisen that world-wide shark catches may not be biologically sustainable. However, there has been a tendency to generalize about the vulnerability of shark populations while in fact different species have different capacities for natural rebound. According to the

analysis by Smith, et al., (1998, p. 673), "the more oceanic species with mid-range r_{2M}-values [population productivity] should be better able to withstand fishing pressure than their late-maturing coastal counterparts." The main species exploited by the Hawaii-based pelagic longline fishery fall into the oceanic category. Further, a review of the current stock indicators indicates that there are no obvious indications of stock depletion for the main shark species caught in the Hawaii-based longline fishery and catches in other Council-managed fisheries are not considered large enough to have a significant impact on the stocks. However, it is difficult to accurately determine the impact of the total catch of sharks by the Hawaii-based longline fleet on Western Central Pacific Ocean, and particularly North Pacific, shark stocks. This suggests that the Council should take a conservative approach.

Alternatives:
Alternative 1 (Preferred) - Implement a precautionary annual harvest guideline of 50,000 blue sharks or sets of blue shark fins that may be landed by the Hawaii-based longline fishery and establish a framework process to allow future adjustments to the annual harvest guideline. In addition, implement a trip landing limit of one non-blue shark, which must be landed whole or dressed.
Alternative 2 - Prohibit the retention and landing of sharks and shark products (including fins) in all Council-managed fisheries and the domestic transshipment of sharks and shark products through US-flag Pacific ports.
Alternative 3 - Prohibit the retention and landing of sharks and shark products by the Hawaii-based longline fishery.
Alternative 4 - Implement an annual harvest guideline for the Hawaii based-longline fleet based on some other measure than the number of landed sharks or sets of fins (e.g. weight).
Alternative 5 - Implement minimum and maximum size limits for retained sharks based on reproductive characteristics of different shark species or prohibit the taking of all female sharks, by the Hawaii based -longline fleet
Alternative 6 - Require more selective gear and/or minimize mortality of released sharks by the Hawaii-based longline fleet.
Alternative 7 - No action.

Economic Impacts:
Alternative 1 (Preferred) - An annual harvest guideline of 50,000 blue sharks or sets of blue shark fins represents a 16.8% reduction from 1998 Hawaii-based longline landings. A 1999 study (McCoy and Ishihara) estimated that 38 metric tons of dried shark fins (mainly from blue sharks) were landed by the Hawaii-based longline fleet in 1998. Using a 1998 average price of $27.50 per kilogram, the ex-vessel value of these fins was $1,045,000. It was also found that on the majority of Hawaii based longline vessels, revenue from shark fins is shared exclusively among crew members. Based on the 114 longline vessels which were active in 1998, each with 3 to 4 crew members, this represents roughly $2,600 per crew member, and was estimated to have provided an income supplement equal to approximately 10% of their regular annual earnings of

$25,000. Assuming a direct relationship between number of fins landed and revenue per crew member, this management measure would be anticipated to decrease this income supplement by 16.8% ($437) as compared to 1998. The Hawaii-based longline fleet took 1,140 trips in 1998 and landed 616 sharks (mako and thresher) for their meat. These sharks brought the fleet a total ex-vessel revenue of $42,000 or $368 per vessel. Assuming that vessels would continue to land whole sharks at the same rate as in the recent past (1998, the latest year for which complete data is available), a limit of one non-blue shark per trip should have no impact on average ex-vessel revenues In conclusion, an annual harvest guideline of 50,000 blue sharks or sets of blue shark fins with a limit of one non-blue shark per trip, is anticipated to lead to an 16.8 % decrease in finning income, which represents a 1.7% ($437) decrease in total annual income per Hawaii longline crew member, and no change to the income of longline owners or captains. Whether this decrease would have a negative impact on crew availability is unknown, some captains have stated that fin money is an important component of crew compensation. Given that the projected decrease is relatively small it seems unlikely that there would be an extensive impact on crew hiring. Also impacted by this alternative would be local traders who buy sharks and shark products from the Hawaii-based longline fleet. McCoy and Ishihara found that in 1998 between $332,000 and $399,000 was generated by local traders dealing with the Hawaii-based domestic longline fleet. Assuming the same scenario as above, this group would see no change in shark meat revenues but would realize a decline of 16.8% in shark fin revenues. This alternative is preferred because it adopts a precautionary approach until further data on shark populations is available, yet still allows for utilization of shark resources.

Alternative 2 - A total prohibition on both the landing and the domestic transhippment of all shark products through US-flag Pacific ports (Hawaii, American Samoa, Guam and the Northern Mariana Islands) would be anticipated to have greater impacts. The landing of foreign caught sharks and shark products in American Samoa, Guam, and the Northern Marina Islands would not be affected as, due to Nicholson Act exemptions which allow foreign vessels to directly offload at these ports, domestic vessels do not participate in the transhippment of foreign fishery products in these areas. However, no such exemption applies to Hawaii and thus any foreign caught fishery products landed in Hawaii must be brought to shore by domestic transhippment vessels. This alternative would prohibit their activity, along with the landings of all Council-managed fishing vessels in all Western Pacific areas. Examining first the impact on domestically caught landings by Council-managed fisheries, the 1999 study by McCoy and Ishihara found estimated that domestic harvest and sale of shark products by Hawaii based longliners resulted in $1,045,000 in shark fin revenues, and another $42,000 through the sale of shark meat. Other locally based vessels (troll and handline) landed an additional 62,000 pounds of sharks, with approximately 24% sold for a total ex-vessel revenue of $34,452. Of these 62,000 pounds, approximately 33,000 are believed to have come from within state waters. A prohibition on the landing of these sharks will require the adoption of complementary regulations by the State of Hawaii. Apart from Hawaii, only in American Samoa and Guam do Council-managed vessels land sharks or shark products. In 1998 total shark landings by American Samoa based troll boats were 208 pounds, with another 7,196 pounds landed by local longliners. Although shark meat is

eaten by some residents, there is no known local commercial market for shark products. A similar situation exists in Guam where locally based small boats have reported landing 26 sharks in the period between 1986 and 1998, with no sales. Although not of commercial value, a ban on these landings would eliminate their home consumption.

Other domestic entities which would be directly impacted by the alternative include a variety of businesses which provide support services to domestic transhipping operations, or act as shark meat or fin processors/traders. McCoy and Ishihara found that in 1998 the Hawaii economy received $235,000 from domestic shark transhippment support services. An additional $332,000 to $399,000 was estimated to have been generated by local traders dealing with the Hawaii-based domestic longline fleet.

In summary, Hawaii businesses realized a total of approximately $1.7 million in direct economic impacts from the domestic landing, sale and transhippment of shark products in 1998. American Samoa fishing operations landed (but did not sell) a total of 7,404 pounds of sharks. A very small amount of sharks were also landed (but not sold) in Guam by its local fleet. This alternative would eliminate the Hawaii revenues as well as the annual home consumption of approximately 7,500 pounds of shark meat in American Samoa and Guam. This alternative was rejected as economically inefficient and overly restrictive, especially given that there is interest in increasing the harvest and utilization of sharks in the non-Hawaii areas where their numbers are believed to be high enough to represent an under utilized resource as well as significant fishery competition for target pelagic species.

Alternative 3 - Based on 1998 data, a prohibition on the retention and landing of shark products by the Hawaii-based longline fleet would annually cost the fleet the $1,045,000 it realizes from the sale of shark fins, as well as the $42,000 realizes from the sale of shark meat. The $332,000 to $399,000 estimated to have been generated annually by local traders dealing with the Hawaii-based domestic longline fleet would also be forgone. This alternative was also rejected as being overly restrictive and economically inefficient.

Alternative 4 - Assuming that the desired level of harvest is the 50,000 sharks indicated in the Preferred Alternative, the economic impact of this constraint will be the same regardless of how this number is set (e.g. based on number of sharks, total weight or some other measure of total removals). Thus the impact of this alternative on Hawaii-based longline vessel operators and shoreside businesses will be similar to that of the Preferred Alternative. This alternative was rejected due to the difficulty and expense associated with the setting, monitoring and enforcement of a weight based quota.

Alternative 5 - The economic impacts of a harvest restriction based on species specific size requirements is difficult to analyze as fishery scientists have been unable to determine the appropriate size limits. Therefore this approach is seen as unfeasible at this time. Assuming that 50% of currently harvested sharks are female, the impact of a prohibition on their harvest would be a 50% reduction in Hawaii-based longline ex-vessel revenues from both shark fins and shark meat. This means that annual fleet ex-vessel revenues arising from the sale of shark fins would fall by $522,500 ($1,200 per crew member) and annual ex-vessel revenues from the sale of shark meat would fall to $21,000 ($184 per vessel). This alternative was rejected due to a lack of

information as to the effect it would have on shark stocks, as well as difficulty with monitoring and enforcement.
Alternative 6 - The simplest approach to a requirement for Hawaii-based longline vessels to use more selective gear and/or minimize the mortality of released sharks would be to mandate the use of monofilament (as opposed to steel) leaders as sharks may bite through these and free themselves more easily. McCoy and Ishihara discuss further possibilities for gear improvements such as changes to the color, placement and number of lightsticks used, changes to hook design and techniques to predict (and thus avoid) ocean areas where sharks are especially prevalent. However, they also note that there is insufficient knowledge at this time to mandate gear changes which would substantially reduce shark catches. For this reason, this alternative was rejected.
Alternative 7 - Under the no action alternative, fishery and fishery support industry costs and revenues would remain unchanged.

Objective 2: Minimize waste and harm to the extent practicable within economic constraints.

Background: Both the Food and Agriculture Organization's International Plan Of Action on Sharks, and the Council's Pelagic FMP emphasize that waste should be minimized. It is easy to see why finning is considered wasteful, since only a small portion of the shark is retained (about 5% of round weight). However, there are serious impediments to the utilization of the most commonly caught shark species, the blue shark. This is reflected in the fact that if a product recovery rate for blue shark is calculated based on landed value, fins represent 72% while the meat represents only 3%, and the liver and cartilage make up the remainder. This contrasts with target species, such as tuna, where the meat represents 91.5% of the total value of the fish. However, several additional concerns are categorized under the reference to "minimizing harm". These include the "existence value," of sharks which refers to the intrinsic value of sharks for cultural, ethical or aesthetic reasons alone. To some, sharks have symbolic value, as a unique life form similar to marine mammals, such that concerns about killing them supercede issues of sustainable use. For some people they may be considered "charismatic megafauna" similar to African big game and should be protected from exploitation for reasons intrinsic to the shark's nature. Additionally, in the past Pacific Islanders frequently expressed relations with other organisms in kinship or mystical terms. In native Hawaiian cosmology, for example, sharks could be an *'amakua*, or *'unihipili*. The first is a beneficent guardian spirit and the latter a spirit under the control of a sorcerer. McCoy and Ishihara briefly review past and contemporary beliefs among indigenous people in the US-flag Pacific Islands. They note that most of the knowledge about which shark species may have been spiritually important to Hawaiians has been lost. Although it is unknown how many contemporary Hawaiians maintain the same type of relationship to sharks as did their ancestors, many are seeking to revive or maintain a distinct sense of cultural identity. Further, the authors quote two statements by native Hawaiians emphasizing a contemporary recognition of sharks as *'aumakua*, even if the precise relationship differs from that of the past. Although a spiritual relationship, like that of native Hawaiians, does

not appear to be an aspect of contemporary culture in any of the other US-flag islands, the McCoy and Ishihara report notes that non-commercial use of sharks, within a context of indigenous practices and mores, continues in American Samoa. A second issue is that the taking of fins may be seen as unnecessarily inhumane, especially if it is thought that this results in a lingering death because sharks are alive when finned.

Alternatives:
Alternative 1- (Preferred): No action.
Alternative 2 - Prohibit the sale, trade, or barter of shark fins in all Council-managed fisheries, and by all domestic transhippers in US flag Pacific ports.
Alternative 3 - Prohibit the commercial landing or transhippment of shark fins by the Hawaii-based longline fleet, without the carcass or a specified percentage of the carcass of each shark.
Alternative 4 - Require a minimum product recovery rate for sharks landed by the Hawaii-based longline fleet.

Economic Impacts:
Alternative 1 (Preferred) - Under the no action alternative, fishery and fishery support industry costs and revenues would remain unchanged. This alternative is preferred as it results in the most efficient economic outcome.
Alternative 2 - Under this alternative the Hawaii-based longline fleet would annually lose the $1,045,000 derived from the sale of shark fins. The $332,000 to $399,000 estimated to have been generated by local shark traders dealing with the Hawaii-based longline fleet would also be forgone, as would the $235,000 generated by domestic transhipper support services. An uncertain amount of revenue realized by the Hawaii-based small boat (troll and handline) fleet from the sale of shark fins would also be lost. How much of the approximately $17,000 generated by this fleet from the sale of shark products caught in Federal waters which resulted from shark fin sales versus the sale of shark meat is unknown. It is believed that sharks landed by the American Samoa and Guam fleets are landed whole rather than finned, thus these landings would not be affected by this alternative. This alternative was rejected because it appears to lead to under utilization of available resources, especially in light of the proposed limitation on shark harvests via an annual harvest guideline.
Alternative 3 - It is believed that this alternative would essentially end the landing of any blue shark products, including the 95% of fins which come from blue sharks, by the Hawaii-based longline fishery. This is due to both physical and market constraints. There are four crucial barriers to the retention of blue shark carcasses: (1) short storage life of the flesh in ice, (2) capacity constraints of Hawaii-based longline vessels, (3) limited deck space on these vessels necessary for proper handling, and (4) low value for the landed product. Blue sharks have especially high levels of urea (or more generally, non-protein nitrogen--NPN--compounds) in their flesh and when the shark dies bacteria rapidly convert this to ammonia, contributing to spoilage. In order to avoid this problem, ideally sharks should be landed alive and rapidly bled in order to remove as much of the NPN compounds as possible. Work spaces have to be kept clean

in order to avoid re-contamination from blood-borne urea, contaminating ice. Blue sharks need to be further processed aboard the vessel in order to remove still more urea. Even after careful processing blue shark meat can be held on ice for no more than five days before spoilage sets in. (This contrasts to frozen shark, which may be held for up to five months.) These characteristics contribute to the first and third constraints outlined above. Hawaii-based longline vessels are also capacity constrained on several levels. First, even if sharks could be held using current ice-chilling methods, the total space available is limited and priority will always be given to much higher valued target species. Ice is also a limiting factor, except for vessels carrying ice makers. Thus by the same token, operators are unwilling to devote significant amounts of ice to chill and hold low value non-target species. In theory, and depending on their design and construction, existing vessels could be refitted with freezer holds specifically for shark carcasses. However, since market conditions demand a fresh product for target species, ice storage would have to be retained. Given size limits on the vessels, a second level of capacity constraint would be encountered to the degree that freezer holds supplants ice storage. Clearly the fourth constraint, low market value for blue shark meat, is an overarching factor. Fundamentally, the costs involved in landing, handling, processing and preserving blue shark meat currently far outweigh the revenue that might be garnered from doing so. In fact, there is currently no established market for blue shark meat in Hawaii. Assuming that the remaining 5% of (non-blue shark) fins would be landed with their associated carcasses, along with the continuation of 1998 levels of mako and thresher shark meat landings, this alternative would result in shark fin landings of $52,250 worth of shark fins and $42,000 worth of shark meat. The value of the carcasses landed with the shark fins is uncertain. Clearly if they had an economic profit, vessel operators would already be landing and selling them. However, this non-blue shark meat may have some economic value, such that although it is not worth bringing them in on their own merit, when included as part of a requirement to land their fins, vessel operators will be able to recover some revenue from their sale. If this is not the case, it is likely that they would be disposed of in landfills, as this alternative only requires their landing, not their actual utilization. Clearly Hawaii shark fin traders would also be affected by such a decline in shark fin landings. Assuming that their profits are directly linked to the number of fins landed, a 95% reduction in landings would lead to an annual decline of between $315,000 and $380,000 realized by these businesses. This alternative was also rejected due to its under utilization of available resources, especially in light of the proposed limitation on shark harvests via an annual harvest guideline.

Alternative 4 - This alternative requires that some specified product recovery rate be met for all sharks harvested by the Hawaii-based longline fleet, and defines this to mean that a specific percent of each shark actually be utilized, either through sale or home consumption. The impact of this alternative is likely to be an end to <u>all</u> shark finning, as if profitable markets existed for the carcasses of any sharks currently finned vessel operators would already be supplying them. Thus, under this alternative the Hawaii-based longline fleet would lose the $1,045,000 derived annually from the sale of shark fins. The $332,000 to $399,000 estimated to have been generated by local traders dealing with the Hawaii-based longline fleet would also be forgone. This alternative was rejected largely because markets would need to be developed before a

requirement to meet a minimum product recovery rate above what is currently achieved would be feasible. In addition, the logistics of enforcing a utilization requirement are difficult to envision.

Objective 3: Regulate bottom (demersal) longlining to prevent adverse impacts on endangered species.

Background: The current regulatory definition for longline gear describes it as "...consisting of a main line that exceeds 1 nm in length, ... suspended horizontally in the water column either anchored, floating, or attached to a vessel, and from which branch or dropper lines with hooks are attached..." The bottom longline gear recently used in the Northwestern Hawaiian Islands (NWHI) did not conform to this definition because the main line was not suspended in the water column but rested on the bottom. Because of this there are no existing measures that may be used to manage this fishery. Although this fishery is not currently active, regulations should be in place to deal with it in the future should it be reactivated. Concerns about this fishing method include the potential for endangered and protected species, especially the endangered monk seal (*Monachus schauinslandi*), to be harmed by the gear. Other concerns included possible impacts on Essential Fish Habitat and Habitat Areas of Particular Concern, infringement on native use rights, problems resulting from lost gear, gear conflicts and the possibility that sharks might be attracted closer to recreational use beaches. In addition, the main target species, the sandbar shark (*Carcharhinus plumbeus*), may be easily depleted; Smith, et al., (1998) categorize it among the more vulnerable slow-growing, late-maturing sharks. Before any management measures can be implemented, this fishing method must be identified and defined in management regulations. It is important to tailor regulations which allow for the specific management of bottom longlining, including spatial variations as representatives from Guam and CNMI, (in contrast to Hawaii), indicated that there is some interest in establishing a shark fishery there, especially since sharks are thought to affect existing fisheries by predating on hooked target species.

Alternatives:
Alternative 1 (Preferred) - Develop a new definition specifically for bottom longline gear, and prohibit its use in the protected species zone in the NWHI as well as in the areas around the Main Hawaiian Islands (MHI) currently closed to longline fishing.
Alternative 2 - Amend the existing definition of longline gear so that it includes bottom longline gear. It will then be included in the current prohibition on the use of longline gear in the protected species zone of the NWHI and the closed areas around the MHI, as well as in the closed area around Guam.
Alternative 3 - No action.

Economic Impacts:

Alternative 1 (Preferred) - A specific prohibition on bottom longlining around the Hawaiian Islands would have no immediate direct economic impact as the one vessel which engaged in this activity has been sold and the operator has left Hawaii. This vessel made two trips around the NWHI in late 1999. Details on the catch and revenue from these trips is unavailable due to confidentiality requirements. Future participation in this fishery would be precluded, however there does not appear to be any interest by other parties. This alternative is preferred as it prohibits the use of bottom longline gear in areas where it is a concern, but allows for its use where it is not a concern.
Alternative 2 - Including bottom longlining in the current definition of longlining would result in a prohibition on its use around the Hawaiian Islands, however it would also prohibit its use in the closed area around Guam. Although there are currently no known bottom longline operations around Guam, there is interest in this activity and no desire to prematurely limit its use there. This alternative was rejected due to its overly broad effects.
Alternative 3 - The no action alternative would have no direct economic impacts but was rejected as it would fail to address concerns for potential interactions with protected species.

Objective 4: Manage sharks under appropriate fishery management plans for each species or species group.

Background: At the present time, shark Management Unit Species (MUS) are defined broadly in the Pelagic FMP. Although the Pelagic FMP states that "the management unit species occupy a pelagic environment during all stages of their lives",this is not reflected in the regulatory definition. This means that shark species rarely caught in pelagic fisheries, but occasionally caught in other Council-managed fisheries, fall under pelagic fisheries regulations. Management may be more effective if shark MUS were specifically defined and those which are primarily coastal species reassigned to other management plans.

Alternatives:
Alternative 1 (Preferred) - No action
Alternative 2 - Define only pelagic sharks as pelagic management unit species, move non-pelagic sharks to other Fishery Management Plans.
Alternative 3 - Define only those sharks that are frequently caught by the Hawaii-based longline fishery (blue, oceanic whitetip sharks, silky sharks, the three thresher shark species, shortfin mako sharks, and crocodile sharks) as pelagic management unit species, move all other sharks to other Fishery Management Plans.
Alternative 4 - Define only those shark species identified in Alternative 3, plus longfin mako sharks as pelagic management unit species, move all other sharks to other Fishery Management Plans.

Alternative 5 - Define only those shark species identified in Alternative 3, plus longfin mako sharks and salmon sharks as pelagic management unit species, move all other sharks to other Fishery Management Plans.

Economic Impacts:
None of the alternatives is expected to have an economic impact on fishing vessel operators or related businesses.

Description of small businesses to which the rule will apply
This rule could affect a variety of fishing entities (vessel owners, operators, and crew members), and fishing support industries including domestic shark fin traders and transhippers. Alternatives which would impact Hawaii-based transhippers would affect the three or fewer operations of this type (the exact number cannot be revealed due to confidentiality requirements). Alternatives impacting the Hawaii-based longline fleet could potentially affect all 164 Hawaii limited access permit holders however they are not likely to affect more than 120 as only 114 were active in 1998 and no more than 115 have been active since 1995. This fleet's 1998 fleet landings totaled approximately 28 million pounds (245,600 pounds per vessel) and fleet ex-vessel revenue was $46.7 million ($410,000 per vessel). A total of 1,140 trips were made by the fleet in 1998, with an average of 10 trips per vessel. An average of 11 sets were made per trip in 1998, with a mean of 1,390 hooks set per vessel per fishing day. Each vessel carries 3-5 crew members in addition to the captain, and the mean investment per vessel was estimated to be $373,000 in 1993. The maximum permitted vessel length overall is 101 feet, and the average vessel is approximately 70 feet in length.

Alternatives which would affect all Hawaii-based vessels would additionally potentially impact the 7,500 small boats which fish both recreationally and commercially from the Hawaiian Islands although how many of these small boats actually landed sharks or shark products in 1998 is unknown. This would also represent the first fishery management measure to be applied to this small boat fleet. Although managed under another fishery management plan, this would also potentially affect the 17 Northwestern Hawaiian Islands (NWHI) bottomfish permit holders (14 active in 1998) who occasionally land shark fins. Alternatives which would control landings in other US flag ports by Council-managed fisheries (American Samoa, Guam and the Northern Mariana Islands) would potentially affect all 50 American Samoa based longline permit holders, of which 26 were active in 1998. Also potentially impacted would be the (unknown) portion of all 24 American Samoa based small boat (troll and handline) vessel operators which land sharks, as well as an unknown (but very small) number of domestic Guam based vessels landing sharks. The McCoy and Ishihara study found that in all of the above locales and fishery sectors (including shark fin traders), revenue from sharks and shark products comprise only a small portion of total revenues. The magnitude of this portion is unknown and difficult to determine as the shark trade is often a somewhat clandestine business which operates mostly on a cash basis.

COST/BENEFIT ANALYSIS OF ALTERNATIVES

Cost/benefit analysis of these shark management alternatives is difficult because the benefits cannot be easily quantified. While costs incurred by the fishery and related industries are fairly easily determined, the benefits are difficult to analyze because of two factors. First, there is no stock assessment for these sharks which would allow estimation of future economic benefits due to conservation of shark stocks. Second, a number of the benefits are hedonic in the sense that they reflect people's beliefs and attitudes towards shark conservation, shark harvesting, and shark products. These hedonic (non-market) benefits have not been quantified in this or any other shark fishery of which we are aware. Fishing regulations focused specifically on the conservation of sharks are needed if the resource is or may be subjected to unsustainable fishing pressure. Whether requirements to achieve specific product recovery rates, to reduce pain or suffering endured by finned sharks, or to address concerns for their existence value will lead to net national benefits is not clear. In the case of product recovery rates, a distinction must be made between physical and economic recovery. For many, shark finning physical recovery rates are unacceptably low, while others see finning as analogous to agricultural and other industries (including a number of fisheries) where a substantial amount of unusable product is seen as an inevitable part of an economically efficient production process. A requirement to land unmarketable and inedible shark carcasses appears economically inefficient as these carcasses will end up taking up space in landfills (which are limited on Pacific islands) rather than being returned to the ocean ecosystem where they can provide benefits to other organisms. There is also segment of the public which clearly feels that sharks have special characteristics which make their individual existence deserving of special protection, regardless of the overall status of their populations. The economic values which this group would derive from an end to all shark deaths are not known. Fortunately concerns for pain and suffering endured by sharks finned alive appear to be unfounded, as this is an uncommon scenario in the Hawaii-based longline fishery which is the focus of these actions. Observers on these vessels recently undertook a 6 month (unannounced) examination of the number of sharks actually finned alive and found that this occurs in only approximately 2% of cases. Again, although it is impossible at this time to determine the magnitude of economic benefits (both monetary and non-monetary) which might result from these actions, there is some information on the costs of alternatives under consideration. Economic impacts on individual entities were outlined above, however some alternatives include further costs to the nation in the form of reductions in government revenues. Examination of alternatives which would end the sale of sharks and shark products in Hawaii and/or American Samoa and Guam found that tax revenues are (or should be) generated by the sale and trade of shark products. The applicable excise tax rate for wholesale products sold in Hawaii is 0.005 percent of wholesale (ex-vessel) price. However, actual collections for shark fin sales taxes are believed to lag far behind this as the majority of shark fin transactions are done on a cash basis and go unreported to tax authorities. If this tax was collected in full, it would have totaled between $4,700 and $5,700 in 1998. Finally, alternatives which limit the domestic harvest of sharks or shark products will reduce supplies available to consumers. Although it is

likely that these would be replaced by an increase in readily available imports of these products, such substitution would represent a net national cost.

Appendix B: Hawaii-based limited entry longline fishery, draft regulatory changes

Title 50, Volume 3, Part 660

§660.12 Definitions

Bottom longline gear means a type of fishing gear consisting of a main line that exceeds 1 nm in length, lays on the bottom or is suspended no more than 1 fathom from any sea bottom 100 fathoms or less in depth for the majority of its length, is anchored to the bottom, and from which branch or dropper lines with hooks are attached.

§660.22 Prohibitions

(z) Fish for Pacific pelagic management unit species with bottom longline gear within the longline protected species zone of the NWHI or the longline fishing prohibited area in the Main Hawaiian Islands EEZ as described in §660.26(c).

(aa) Land an oceanic shark pelagic management unit species unless the whole carcass, exclusive of internal organs, is landed, except for the blue shark (*Prionace glauca*).

§660.32 Harvest guideline for oceanic sharks.

(a) General. A harvest guideline for vessels holding a Hawaii longline access permit will be set annually for the calendar year and shall:

(1) Apply to the total landings of oceanic sharks, or any part thereof, considered Pelagic management unit species.

(2) Be expressed (i) in terms of numbers of sharks landed whole or dressed, or

(ii) in terms of number of sharks from which fins (or parts thereof) have been removed. This number of sharks may be determined from the number or weight of fins landed.

(b) Harvest guideline. (1) The harvest guideline for blue shark (*Prionace glauca*) is 50,000. For all other oceanic shark Pelagic management unit species the harvest guideline is one shark per vessel per fishing trip.

(2) The harvest guideline may be modified by the framework adjustment process for established measures described in §660.31(c).

(3) After the initial year in which these regulations become effective NMFS shall publish a document indicating the annual harvest guideline in the Federal Register by February 28 of each year and shall use other means to notify permit holders of the harvest guideline for the year.

(4) The Regional Administrator shall determine, on the basis of the information reported to NMFS by the operator of each vessel fishing, when the harvest guideline for oceanic sharks will be reached.

(5) Notice of the date when the harvest guideline for oceanic sharks is expected to be reached and the specification date after which oceanic sharks may not be retained or landed will be provided to each permit holder and/or operator of each permitted vessel at least 14 days in advance of the anticipated date. After that date the retention on board, transfer to a receiving vessel, or landing of oceanic sharks by permitted vessels is prohibited.